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F. C. Nesbitt

Editor

JANUARY - 1931

A McGraw-Hill Publication

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One Responsibility for the Complete Texrope Drive

THE belts as well as sheaves for V-belt drives are *equally* important.

When the diameter of the driver sheave is less than established minimums, the belts will not give long service. Bending a belt over too small a sheave subjects the cords to constant flexing at a sharper angle than good practice permits.

In recommending the correct size Texrope Drive, Allis-Chalmers engineers recognize these facts . . . and take them into consideration.

The result of this long-established policy is that over 95,000 Texrope Drives are now in use . . . and on many of the first drives sold the original belts are still in service.

The newest type Texrope Belts possess amazing flexibility . . . and have proved that they will give even longer service than the older ones. They represent years of development by Allis-Chalmers and Goodrich.

In the manufacture of sheaves, Allis-Chalmers has minimized vibration by perfect machining and absolute accuracy. But you buy *more* than sheaves and belts when you buy from Allis-Chalmers. You buy a *complete drive, correctly engineered, and guaranteed by a company with more than eighty years experience* in the production of power machinery.

The Whole Story of the Texrope Drive in 8 Minutes. Ask for a copy of Bulletin 1228.

Let us show you the economy of the Texrope V-belt Drive . . . silent, slipless and 98.9% efficient.

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INDUSTRIAL ENGINEERING

A McGraw-Hill Publication, founded 1882

JANUARY, 1931

ROOFS FOR INDUSTRIAL BUILDINGS

By H. S. JACOBY

Chief Engineer
The H. K. Ferguson Company
Cleveland, Ohio

In theory, water will not stand on a "level" roof. Settlement of purlins caused this condition.

Roofs of the built-up type are so called because the waterproofing consists of alternating layers of felt cemented together with bituminous material

BUYING a roof is somewhat analagous to buying paint in that an extremely wide variation of price often occurs. In each case cheap unsuitable ingredients may be used by the manufacturer and cheap careless methods by the applier. But just as there are reliable high-grade paint manufacturers so there are honest manufacturers of roofing who have a reputation to maintain. They may be depended upon to supply materials according to specifications and to back up their materials with a guaranty. It is highly important, when contracting for a roof in place, to see that the materials come from a manufacturer of unquestioned reputation. It is equally important that the applier be not only skilled in the business of building roofs, but imbued with the intention of doing the work in a thorough, conscientious manner.

As a general statement, it is essential that the deck should always be firm, reasonably smooth, and free from projections such as poorly seated nails, loose pieces of concrete, or other items which might

cause damage to the roof covering.

Wood sheathing must be thoroughly dried out and well nailed to supports in order to avoid excessive shrinkage and warping. Concrete and gypsum roof decks are subject to damage by rain and frost and should be dry when roof covering is applied. Where insulating materials are used under the roof it is good insurance to segregate the insulating layer into sections approximately 30 ft. square by means of strips of felt so that possible damage from water may be confined to a limited area.

Types of Built-up Roofs

Built-up bituminous roofs may be considered under two general classifications, namely, tar and gravel roofs and asphalt smooth-surfaced roofs. The former consists of three or more plies of tar-saturated felt mopped in place with pitch and covered with a poured coating of pitch in which is imbedded a liberal quantity of gravel or slag.

Asphalt roofs with a smooth surface are constructed in a similar manner except that the felts are saturated with asphalt instead of pitch and that asphalt is used between all the felts and as the final coating.

While it is probably true that four plies of 15-lb. asphalt felt give a better roofing job for any condition than the same total weight of materials with a lesser number of plies, nevertheless it has become the custom to lay a so-called 4-ply asphalt roof using one 30-lb. felt covered with two 15-lb. felts. In addition to being cheaper, this type of construction has some advantage in the fact that the heavier sheet at the bottom is better able to withstand the strains resulting from contraction and any distortion of the building.

Without question asbestos felts offer definite advantages as roofing material. With their low capillarity they absorb only approximately one-third as much of the saturating material as does a rag felt; nevertheless over a period of time an asbestos felt will retain a considerably greater amount of bitumen.

The desirability of a safety factor in the felt immediately applied to the deck has led to the development of the combination-type roof employing a rag felt for the base sheet, usually 30-lb. weight, with two or more cap sheets of asbestos felt. This provides an excellent construction combining the strength of rag felts at the point where the strain is greatest with the durability of the asbestos felts at the surface where the tendency toward evaporation of asphalt is more pronounced.

Selecting the Type of Roof

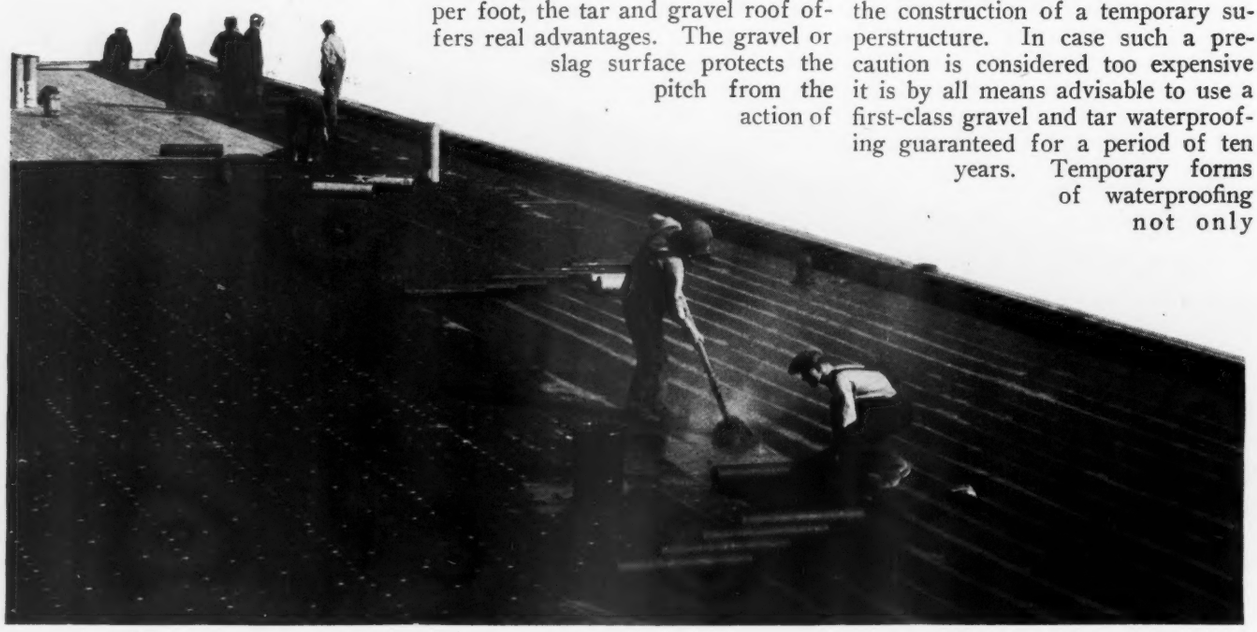
For a comparatively flat surface with slopes not exceeding two inches per foot, the tar and gravel roof offers real advantages. The gravel or slag surface protects the pitch from the action of the sun's rays and limits the disintegration and evaporation. The amount of walking or other traffic on a relatively flat roof is apt to be considerably more than on a sloping roof and the gravel coating adequately protects the deck from damage.

The higher melting point of the asphalt makes the built-up asphalt roof more stable on slopes. With the omission of the gravel topping this type is considerably cheaper than the tar and gravel roof. Also, a leak in an asphalt roof is readily detected and easily repaired.

An air view of most large cities will disclose many buildings planned for additional stories but with the existing top floor roofed over on a perfectly flat surface. Here are combined a hazardous roofing condition with a perfectly natural desire to buy a temporary roofing at a low price. Theoretically little water should stand on a dead flat surface but in practice such a roof has low spots in which water of varying depths accumulates and stands for several days. The presence of water on the deck for a considerable period of time is likely to develop any existing weakness to the point of actual leakage which might never be apparent if the water were permitted to run freely from the roof. The specification of one of our largest corporations requires that all water drain quickly from all portions of the roof.

With these facts in mind, it is good business to provide a definite slope on the roof deck, either by the use of light-weight cinder concrete fill or the construction of a temporary superstructure. In case such a precaution is considered too expensive it is by all means advisable to use a first-class gravel and tar waterproofing guaranteed for a period of ten years. Temporary forms of waterproofing not only

Workmanship is of utmost importance to the success of a roof covering. Note the full mopping of asphalt with the roofing felt following close behind the mop. The base sheet is amply nailed. There are no wrinkles on this roof.



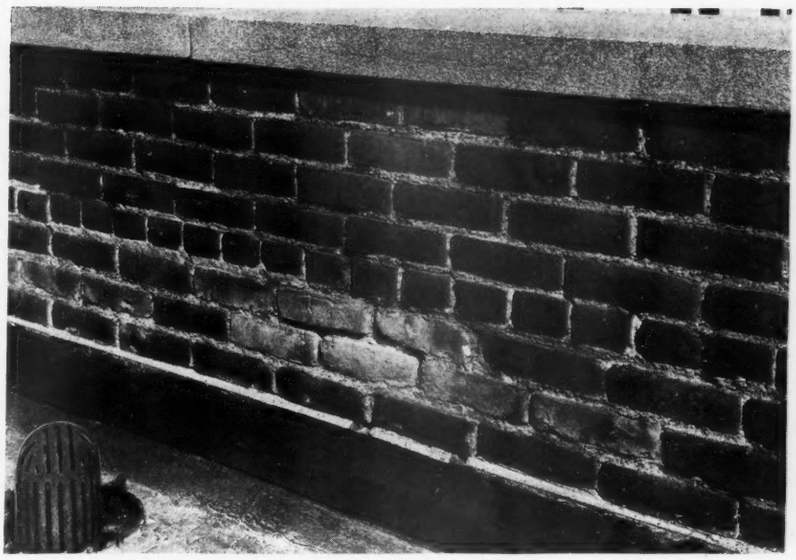
have a shorter life but also constitute a considerable hazard in damage to building and contents. Not infrequently what is at first planned to be temporary construction later develops into a permanent item, in which case the advantage of using a first-class waterproofing is the more apparent.

Approval of Materials

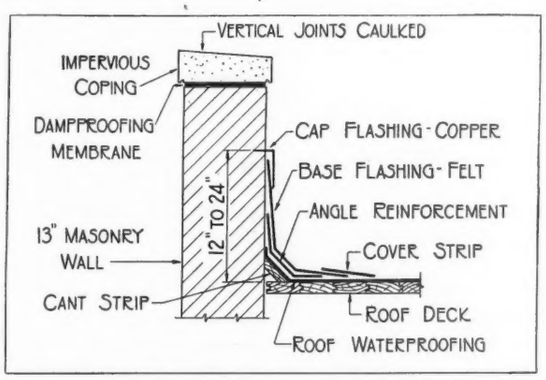
The use of roofing felts and bitumens bearing the label of a manufacturer of national reputation may usually be regarded as a sufficient assurance of quality.

The physical characteristics of pitch and asphalt are difficult to appraise without the aid of technical apparatus. Lacking a laboratory report, it is best to rely upon the manufacturer's brand as an indication of quality rather than the uncertainty of field inspection.

Perhaps the most effective method of checking roofing materials lies in the total weight of felts and bitumen delivered and used on the work. The continued usefulness of a roof covering is dependent, in practically all cases, on the actual quantity of the waterproofing materials employed. Granting reasonably good workmanship, the greater the total weight of the saturated felt and bitumen used the longer the roof will last and better the service it will give.



Brick and mortar of proven durability are necessary to withstand the intense weathering action against the roof side of the parapet. Plastic cement at the flashing reglet will prevent the loss of this joint due to expansion and contraction of the metal.



The parapet—typical construction.

The Importance of Good Workmanship

The best roofing materials cannot make a first-class roof covering except when they are properly applied. The most important consideration in the construction of a built-up roof is the proper mopping of the felts. Specifications frequently read, "Each felt shall be laid in a full mopping of bitumen and in no place shall felt touch felt." This requirement must be adhered to throughout the work except when dry sheets are specified. In general the mopping of bitumen should be carried full to the edge of the felt. The felt should be rolled into the bitumen while it is hot and when in place should be perfectly flat without wrinkles or buckles.

Another important factor in built-up roofing construction is the nailing of the felts. On wood sheathing nailing is required not only at every lap but through the center of the felts as well. When building doors are left open a strong gust of wind exerts a considerable pressure on the underside of the felts, the amount depending upon the extent of drying out and shrinkage of the roofing boards.

All nailing of roofing felts should be through flat metal washers. I have observed roof covering actually torn from the deck by wind due entirely to the omission of suitable caps on the nails. There is no particular advantage in using galvanized nails in built-up roofing work because of the protection against rust afforded by the liberal moppings of bitumen.

Some adequate method must be provided for nailing to concrete decks on slopes. This may be accomplished by the use of a special form of concrete, such as "Nailcrete," or by the insertion of wood nailing strips at necessary intervals when the deck is cast.

The temperature at which the bituminous material is prepared for mopping is usually around 300 to 400 deg. F. Excessive heat has a detrimental effect and should be avoided. The best waterproofing is done with pitch and asphalt exactly in the condition in which it was originally prepared by the manufacturer and it is wise to insist that the bituminous materials be applied to the roof without adulteration.

A very effective method of checking workmanship is the so-called "cut test," in which a portion of the finished roofing is cut from the deck. The sample of roofing will show exactly how all the plies have been installed and give an accurate check on the total weight of roofing materials used. One cut test for each 25 squares of roofing is adequate and custom in roofing permits the requirement in the specification that up to this number of cuts shall be made and replaced by the roofer.

In the event the cut test shows some shortcoming, in felts, or bitumen, or their application, it is customary to require the roofing contractor to cover all of the roof represented by the test with one additional mopping of bitumen and one

Wrinkles and buckles are always potential sources of roofing failure. Felts separated from the deck are subject to extraordinary abuse and cracks are inevitable. The results are especially serious on poorly drained level decks.

additional thickness of asbestos felt.

Guaranties are general in roofing practice. The owner thinks in terms of a specialized product which will last 10, 15, or 20 years without attention on his part or failure of the roof. Actual experience, however, demonstrates that many roofs fail or require maintenance before the guaranty period elapses while others outlive this period as much as 50 per cent.

The owner should look upon the guaranty as a safety factor—the life of the roof will depend upon the specification adopted, the quality of materials, and the character of workmanship. In many instances the roofer has gone out of business within 10 years; in other cases he is not in position to assume the responsibility. I have observed many instances where the owner has not only experienced the periodic annoyance and suffered damage of goods due to poor guaranteed roofs but has, in repair, more than made up for the cost of a first-class initial job.

As an added precaution after selecting a reputable roofer, the owner should require the guaranty to be endorsed by the manufacturer of the roofing material. The manufacturer has a reputation to maintain, he is backed up with physical assets, and he will not endorse other than a reliable roofer, and having entered into the guaranty the manufacturer will see that the roof is applied correctly.

Some manufacturers will not furnish a guaranty unless accompanied by a surety bond. The fee of this bond is naturally added to the cost of the roof. The writer questions the justification of expense involved in a bond providing the roofer and manufacturer are reliable.

Making the Parapet Wall Watertight

The parapet wall is intimately related to the roof waterproofing problem. Not only are breaks more frequent at any angle of a material, but the settlement and vibration of the building must be taken up by the flashing at the junction of the main roof with the parapet.

To reduce the right angle junction, a fillet or cant strip is inserted. The main roofing felts are cut off at the top of the cant strip and the angle is reinforced with the same number of plies of felt as the roofing proper, extending up the wall at least 4 in. and out on the deck a corresponding distance.

Over the reinforcement, and forming the principal element of protection, is the base flashing, usually consisting of a single sheet of extra heavy prepared felt, the exposed surface being coated with slate. This base flashing is mopped solidly in place against the standing wall and extended out on the roof about 6 in. It is important to seal the outer edge down to the main roofing felt with a cover strip consisting of one or two plies of felt approximately 8 in. wide.

In case the parapet wall is not over 1 ft. 6 in. high, the flashing is carried up and across the width of the wall under the coping. For higher walls the flashing is carried at least 1 ft. above the cant strip but not over 2 ft., ready to receive the counter flashing.

Although various roofing manufacturers recommend composition counter flashing, I feel that the metal cap flashing, preferably copper, has a distinct advantage. Free from the base flashing itself, and yet formed over and just above it, any opening of the upper edge of the base flashing is still protected by the metal cap flashing.

Having dealt with the parapet below the cap flashing level, it is essential to make the wall above this line impervious to moisture. The inside surface of the wall should be laid up in durable shale brick with full weather-struck joints. Either the base flashing or a separate membrane full width of the wall should be used to seal off any water entering from above. The coping stone should be impervious; vertical joints should be topped with elastic caulking compound to permit expansion and contraction without opening up the joints.

The term "gutter" refers to the low portion of the roof deck which conducts the water to the drains. This area is subject to more severe conditions than the balance of the roofing. Good practice requires one additional ply of felt for the full area of all valleys and gutters, carrying this ply at least 2 ft. up the adjoining slope.

Unless properly fastened and protected, the edge of the roof at overhanging eaves is subject to damage by wind. Bending the felt over the roof deck is apt to cause breaks. At small additional cost copper edging strips will hold the felts in place, prevent spilling of asphalt, and act as a gravel stop.

Drainage sumps should primarily function to convey the water quickly to the downspouts. This requires that they be set low so that after the roofing felts and finish are in place they do not dam up water on the roof deck. Copper flashing flanges extending about 6 in. from the roof sump are recommended as a precautionary measure to prevent leakage adjacent to the sump due to failure of felts at this point.

Maintenance and Restoration

The owner with his 10- or 20-yr. guaranty may be tempted to neglect maintenance. At least annual inspection is advisable to detect incipient failures before any appreciable damage is done. Bare spots on the surface due to shortcomings in the

application of the final mopping should be coated. Wrinkles in the felt which have broken through should be patched. Debris should be removed from the roof deck. A poorly saturated cap sheet should be re-mopped and an additional ply of first-quality felt applied.

Frequently it is difficult to locate the cause of a leaky roof. Water may travel along wood or steel supports and drop to the floor at a point far removed from the roof failure. Observation during a rain or when the roof is deliberately flooded with a hose usually will determine the location of any failures.

Leaks near a wall are often caused by breaks in the flashing or penetration of water in the parapet wall. The former can be detected readily but the latter may require a continual stream of water analogous to a penetrating rain.

The owner should give serious consideration before incurring any considerable expense in roof maintenance. A few repairs of roof felts are certainly justifiable. I do not advocate the use of miscellaneous roof coatings and paints. A hot coat of high grade asphalt mopped on the surface of a smooth type roof a few years prior to the guaranty expiration period may at small expense extend the life of the roof two years beyond this guaranteed period. If it is evident that the top felt has lost its bitumen by evaporation but some of the lower felts are in good shape and the intermediate moppings of asphalt are intact, the expense of an additional ply of felt with its mopping may be justified and the life of the roof prolonged 5 to 10 years. On the other hand, if all the felts have become watersoaked and have lost their bitumen entirely, a new topping would go to pieces very rapidly and not be a good investment. This same expenditure would buy more roofing years if used as a part of the purchase price for a new roof.

Just as the automobile owner can determine the time to purchase new tires rather than fix up the old ones with the involved inconvenience and expense, so the building owner can determine the time when it is good business to buy an entirely new roof.

They Saved in Handling

THE JOB: Storage and Salvage

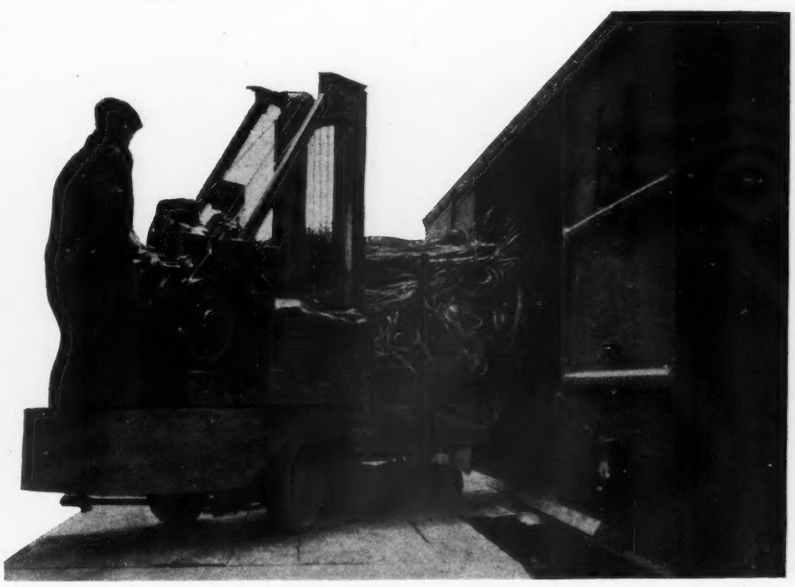
EQUIPMENT: Powered Trucks

SAVINGS: From 60 to 92.4%

IT is not generally appreciated that the electric power company is faced with a complex materials-handling problem in connection with its storage and salvage operations. An example as to the extended use of electric-powered trucks in these operations as a means of reducing the problems to their simplest terms is to be found at the warehouse and salvage yard of a large public utility —the Detroit Edison Company.

This warehouse handles distribution transformers, oil switches, line hardware, and similar equipment. The reclamation operations cover the removal of insulation from scrapped wire, the crushing of burned out lamps, and the baling and shipping of waste paper. The warehouse is located adjacent to a spur track, and the yard, although provided with paved runways, is for the greater part unpaved. Incoming cars are unloaded at the warehouse, whereas scrapped material is unloaded from motor trucks. After burning off the insulation from old wire it is moved either into storage or directly to cars.

For a large majority of this work two electric high-lift trucks of five-ton capacity are used. A motor truck arriving at the yard with old wire loaded on skids is unloaded in approximately ten minutes, thereby effecting a considerable saving in the waiting time of the trucks. The skid loads of wire are then transferred by means of the electric truck to the furnaces. When the wire is removed from the fur-



Fewer freight cars are needed to take reclaimed wire because the wire can be tiered to greater heights with high-lift electric trucks.

naces it is compressed into a compact bundle and transferred to storage or directly into freight cars.

This method of handling material has been responsible for a 90 per cent reduction in the cost of labor. Where it formerly cost 98c a ton to get the reclaimed wire in the car the same operation is now performed by means of trucks for 10c a ton. A ramp having an 11 per cent grade has been built from the yard to the car loading platform, which the electric truck has no difficulty in negotiating. The truck is then used to tier and ram the bundled wire into place after depositing it in the car.

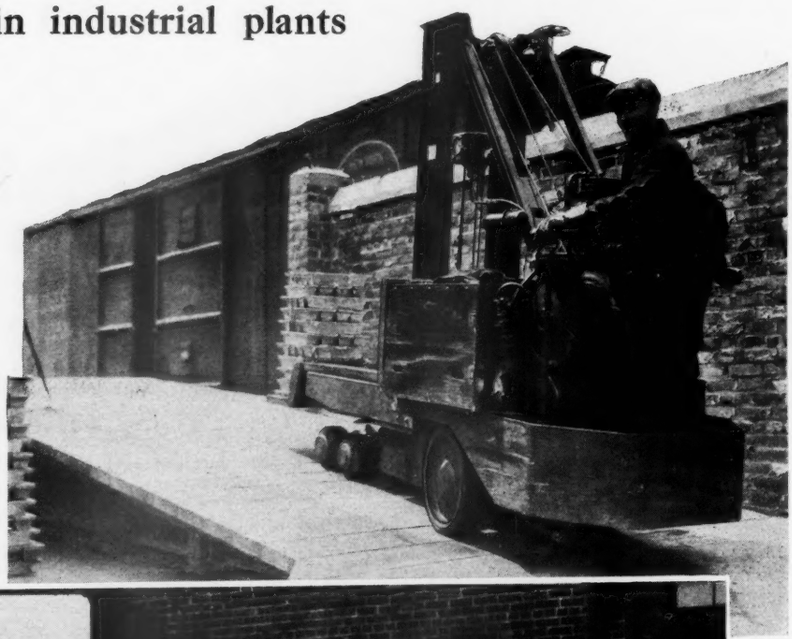
In this way 80,000 lb. of wire can be loaded per car with a resulting reduction in the number of cars used for this service. An added advantage in the use of the truck is the safety factor, strained backs and injuries in the copper-handling operation being entirely eliminated.

Handling baled waste paper from storehouse to freight cars by means of the trucks has shown a considerable saving owing to the ability of the high-lift truck to tier the bales in the car. The costs of the two methods of handling for this operation are not comparable because the baled paper is now stored in a different location since the purchase of the trucks; however, it is estimated that the savings made by their use in this operation are approximately 60 per cent.

In the salvaging of underground cable the lead sheath is melted and run off into pigs. The handling of these pigs to storage and from storage to freight cars formerly cost 9c a ton, but with the use of a forked arm bolted to the platform of the electric truck the lead is now handled at a cost of 2c a ton or at a saving of 77 per cent.

When the electric truck proved so successful in the work it was originally intended to do, the management found other duties for it to perform. For instance, in the lamp crushing operation for salvaging the brass in the base of the burned-out lamps, the crushed glass was formerly shoveled from the hopper below the crushing machine into barrels and the barrels hand trucked to a crane which hoisted and dumped them into a dump truck. To use the electric truck in this operation a metal box was made to replace the hopper under the machine

A "Central Station" example applicable in industrial plants



Transporting 4,000 lb. of pig lead from cars to warehouse. The special fork attachment used is quickly placed on the regular lifting platform.

With the material to be handled piled on skids it is possible to unload a motor truck at the warehouse in approximately ten minutes.

Handling reclaimed wire into and out of furnace for the removal of insulation.

into which the crushed glass drops. The platform of the truck is inserted beneath the box which lifts and carries it to the crane which dumps it into the dump truck. The total time taken formerly was 6.5 man-hr.; that is, one man 2 hr. shoveling and cleaning up and three men 1½ hr. to load a dump truck. It now takes one operator ½ hr. to load a dump truck or 0.5 man-hr., with consequent saving of 92.4 per cent.

These two powered trucks also have been responsible for a considerable saving in general labor costs around the yard owing to the decrease in the number of men employed.

A meter installed on the truck-charging circuit at the warehouse shows that the power required for charging one truck averages 15.1 kw.-hr. per operating day, and excepting for minor maintenance and repairs which is in the neighborhood of 50c a day, there is no other operating expense. The trucks perform satisfactorily even in the unpaved portions of the yard and they have been in continuous use during the entire winter. The savings have largely been effected through the handling of large-sized units as these trucks have a rated capacity of 10,000 lb. each, and their use of 250 skids and a few metal boxes eliminated a large amount of the rehandling which formerly it was necessary to perform.

Power Exposition and Society Meetings

COINCIDENT with the Power Exposition in the Coliseum, Chicago, Feb. 10 to 14, will be held meetings of the Midwest Power Engineering Conference and the Fuels Division of the A.S.M.E. The meetings will be held in the Sherman Hotel.

The exhibit at the Coliseum is expected to present the products of over 240 manufacturers of power plant equipment and appliances, and should be of particular interest to power engineers and executives.

Power economies, prime movers, developments in the electrical field, refrigeration and ventilation, furnace design, and the use of refinery waste fuels in modern steam plants are a few of the topics on the program for the society meetings.

Standard Values Adopted for Wood Poles

NEW American Standard values for the strength of wood in the form of poles are announced by the American Standards Association, 29 West 39th St., New York, N. Y., as follows: Creosoted southern pine, 7,400 lb.; chestnut, 6,000 lb.; western red cedar, 5,600 lb.; and northern white cedar, 3,600 lb. per square inch.

Under the provisions of the National Electrical Safety Code the new values automatically replace the old figures of 6,500 lb. per sq. in. for dense yellow pine, and 5,000 lb. per sq. in. for other yellow pine, chestnut and western red cedar, that have been in general use by pole-line engineers. Northern white cedar remains unchanged.

Ignite Oxy-Acetylene Blowpipes with Friction Lighter

ALWAYS use a friction lighter for igniting oxy-acetylene blowpipes. Many burns have resulted from the use of matches for this purpose.

PLANNING POWER DISTRIBUTION

For continuity of service, ease of expansion flexibility of control

By W. R. CHAMBERS

Chief Engineer
General Steel Castings Corporation
Eddystone, Pa.

How these ideals have been translated into realities at the Eddystone plant of the General Steel Castings Corporation

AMONG the considerations that had constantly to be kept in mind when laying out the distribution system of the new $13,000,000 Eddystone plant of the General Steel Castings Corporation, service continuity came first. Operating conditions are severe in any foundry, but that fact will not prevent losses from, nor can it be accepted as an excuse for, interruptions when castings weighing 100,000 or 150,000 lb. apiece are being made. Flexibility for future additions or changes of equipment was another important consideration.

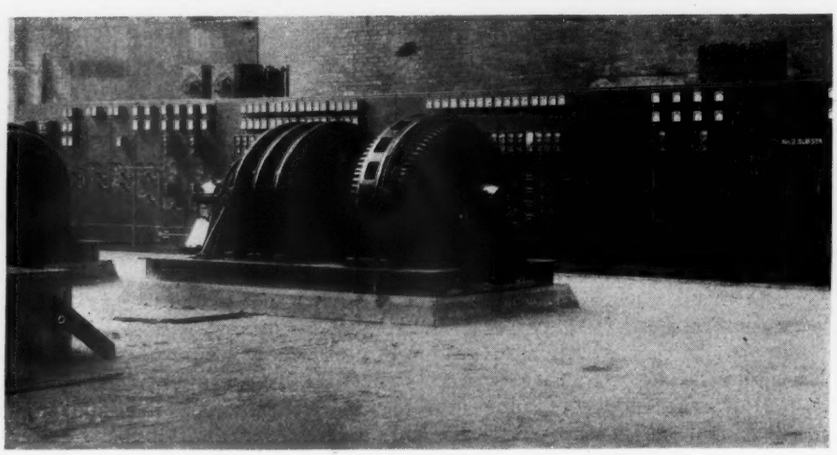
The Eddystone plant covers an area of approximately 113 acres, and comprises a machine shop 990 ft. long by 192 ft. wide, a foundry building 1,196 ft. long by 270 ft. wide, a service building, pattern storage, office building, cafeteria, power-house and sundry small structures. The plant will be devoted exclusively to the production of steel castings of every description, particularly for locomotive and railroad work. It has a capacity of 60,000 tons a year, and has ample facilities for producing castings weighing from 20 lb. to 150,000 lb. apiece—the largest so far made.

Electrical energy for use of the General Steel Castings Corporation, Eddystone, Pa., is purchased from the Philadelphia Electric Company and delivered at 13,500 volts, three-phase, to a large substation located near one end of the service building. Space is provided in this substation for three banks of 13,200/ 2,200-volt transformers, two banks of 2,200/ 220/ 110-volt lighting transformers, two banks of 2,200/ 440-volt transformers, eight 13,000-volt truck switches, twenty 2,200-volt truck switches, a main switchboard adequate for the ultimate development, three motor-generators and three air compressors. The buses and feeder breakers for the 440-volt and 220/ 110-volt circuits are installed on balconies over their respective transformer banks, space being provided for 36 circuits on each balcony.

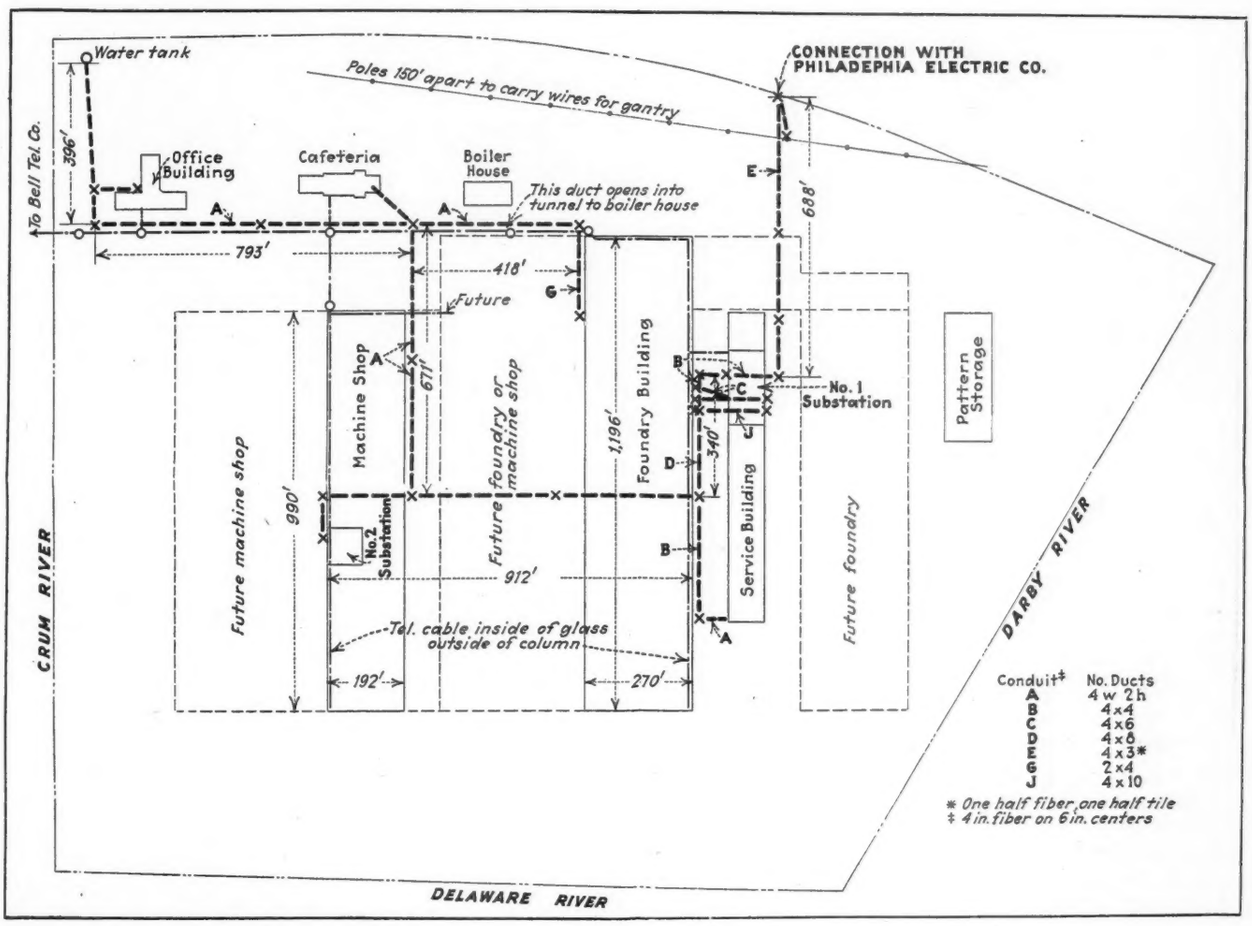
A second substation, measuring 86x90 ft., is located in the roof trusses of the machine shop, and contains space for three banks of power and lighting transformers, twenty-two 2,200-volt truck switches, and 72 power and lighting breakers.

Automatic reclosing breakers set for a 10-sec. interval before reclosure are used on the d.c. switchboard. In order to correct the lagging power factor of the induction motor load throughout the plant, and to keep the power factor above 95 per cent, synchronous motors operated at leading power factor are used to drive the motor-generator sets and air compressors.

Including the cranes, there is at present a load of 3,968 hp. in 250-volt d.c. motors in the foundry, and 1,750 hp. in the machine shop. The load in 440-volt a.c. motors amounts to 1,390 hp. in the foundry, and 270 hp. in the machine shop, with an additional a.c. load of 500 kw. and 200 kw. respectively at 220/110 volts.



Main switchboard and motor-generator set in No. 1 substation. The equipment in No. 2 substation can be controlled locally or by remote control from No. 1 substation.



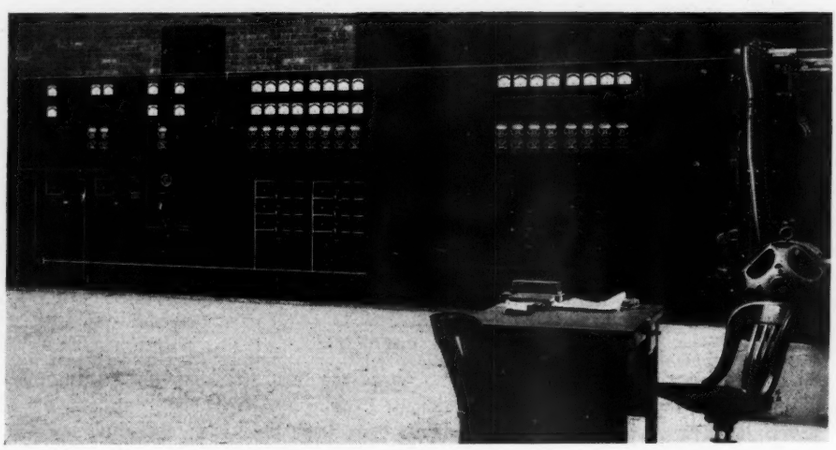
General layout of plant, with location of main underground feeders supplying the various buildings.

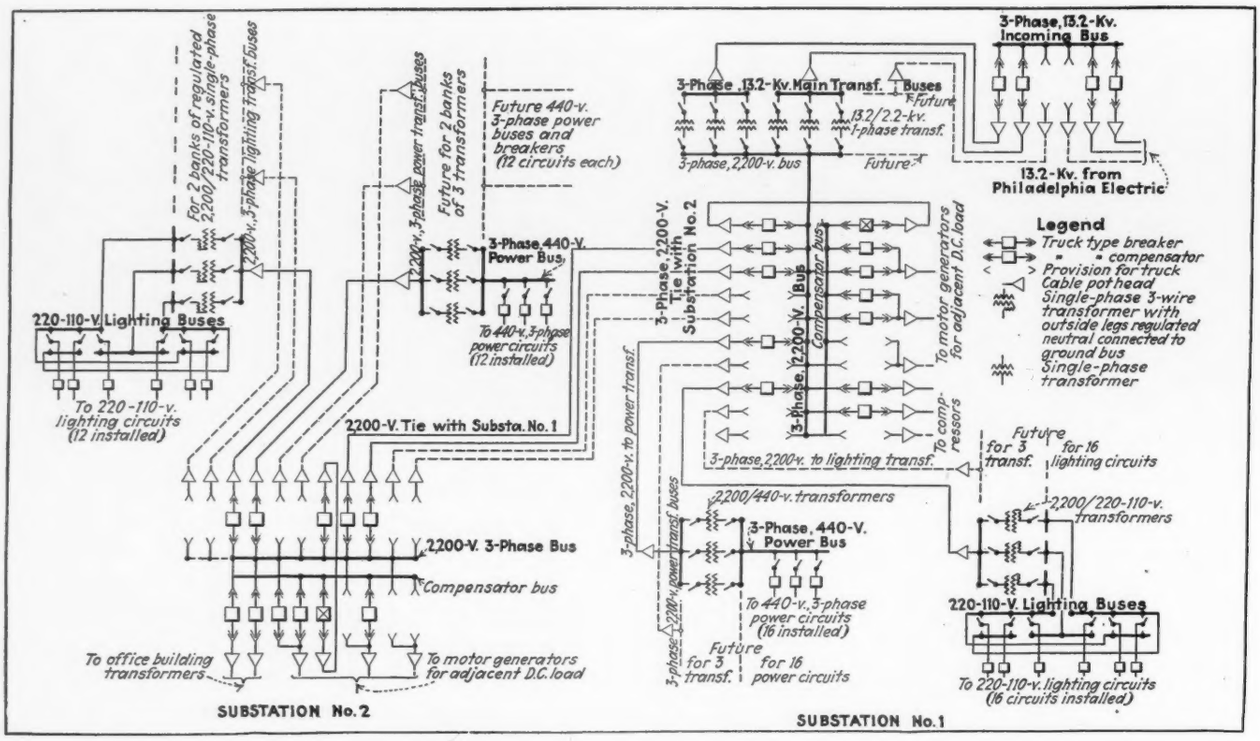
It would, of course, have been possible to locate the motor-generator sets for the d.c. service, and transformers for the 440- and 220/ 110-volt services, close to the load centers in the foundry and machine shop and supply them from 2,300-volt feeders. However, such an arrangement would have meant spreading the above equipment, with its associated control and protective devices, over an area of more than 500,000 sq. ft. of floor space. The foundry and machine shop are 450 ft. apart.

The alternative of concentrating all of the necessary equipment in one substation also had a number of disadvantages. Among these was the fact that it would have entailed considerable distribution losses in the ultimate plant. Also, it would have meant too great a concentration of important equipment in one place. It was, therefore, decided to install two substations. The diagram on this page shows the main electrical connections in and between the substations. Duplicate 13,200-volt feeders from the Philadelphia Electric Company's system are brought into No. 1 substation through underground conduits having spare ducts for additional circuits. The incoming power is metered twice—by the Philadelphia Electric Company and by the General Steel Castings Company. At present two banks of power transformers are installed for the incoming power. Each bank has sufficient capacity to serve the entire plant, leaving one bank as a spare.

In order to give better regulation of the lighting circuits under unbalanced conditions, induction regulators are connected in the low-voltage sides of the lighting transformers.

It will be noticed in the diagram on page 10 that ample provision has been made for spare circuits and equipment, as well as for future extensions. For example, in substation No. 1 there are arrangements for triplicate power supply, triplicate banks of main transformers, duplicate power and lighting transformer




For 2 banks of regulated 2,200/220-110-v. single-phase transformers
2200-v., 3-phase lighting transf. fuses
220-110-V. Lighting Buses
To 220-110-v. lighting circuits (12 installed)
2200-v., 3-phase power transf. fuses
Future for 2 banks of 3 transformers
Future 440-v. 3-phase power buses and breakers (12 circuits each)
3-Phase, 440-V. Power Bus
To 440-v. 3-phase power circuits (12 installed)
2200-V. Tie with Substa. No. 1
2,200-V. 3-Phase Bus
Compensator bus
To office building transformers
To motor generators for adjacent D.C. load
SUBSTATION No. 2
3-Phase, 13.2-Kv. Incoming Bus
3-Phase, 13.2-Kv. Main Transf. Buses
Future
13.2/2.2-kv. 1-phase transf.
3-phase, 2,200-v. bus
Future
13.2-Kv. from Philadelphia Electric
Legend
Truck type breaker
compensator
Provision for truck
Cable pothead
Single-phase 3-wire transformer with outside legs regulated neutral connected to ground bus
Single-phase transformer
3-Phase, 2,200-V. Tie with Substation No. 2
3-Phase, 2,200-V. Bus
Compensator bus
To motor generators for adjacent D.C. load
To compressors
3-phase, 2200-v. to power transf.
3-phase, 2200-v. to lighting transf.
Future for 3 transf.
for 16 lighting circuits
2,200/440-v. transformers
2,200/220-110-v. transformers
3-Phase, 440-V. Power Bus
To 440-v. 3-phase power circuits (16 installed)
3-phase, 2200-v. power transf. buses
Future for 3 transf.
for 16 power circuits
220-110-V. Lighting Buses
To 220-110-v. lighting circuits (16 circuits installed)
SUBSTATION No. 1

Switching facilities in the two substations provide for maximum flexibility and ease in handling future growth of loads. Continuity of service has been assured by provision in substation No. 1 for triplicate power supply, triplicate main transformer banks, duplicate power and lighting transformer banks, a multiplicity of power and lighting feeders, and truck-type circuit breakers.

banks, a flexible switching arrangement for lighting, and triplicate compressors and motor-generators.

Between substations Nos. 1 and 2 there are provisions for four 2,200-volt and four 250-volt d.c. tie circuits. In substation No. 2, arrangements have been made for triplicate lighting and power transformer banks, triplicate motor-generators, and flexible switching for the lighting circuits. The use of truck switches means quick replacement in case of failure, as well as ease of inspection and maintenance.

In not all cases, however, have buses been duplicated or sectionalized. The 13,200-volt truck bus, the 2,200-volt bus for the main transformers and truck switches, and the 440-volt power bus are not sectionalized, for example, nor is provision made for throwing the circuits on duplicate buses.

The reason for not duplicating the truck buses is because very little trouble has been experienced with 2,200- and 13,200-volt buses that are so inclosed. The 2,200-volt bus for the main transformers was not duplicated or sectionalized, because it is installed outside of the transformer fire walls. The 440-volt buses were not sectionalized for the same reason, although this can easily be done if desired. In both cases the transformers can be changed from delta to open-delta operation by means of bus disconnects located outside the fire wall. The 440-volt bus was not duplicated because little trouble has been experienced at this voltage.

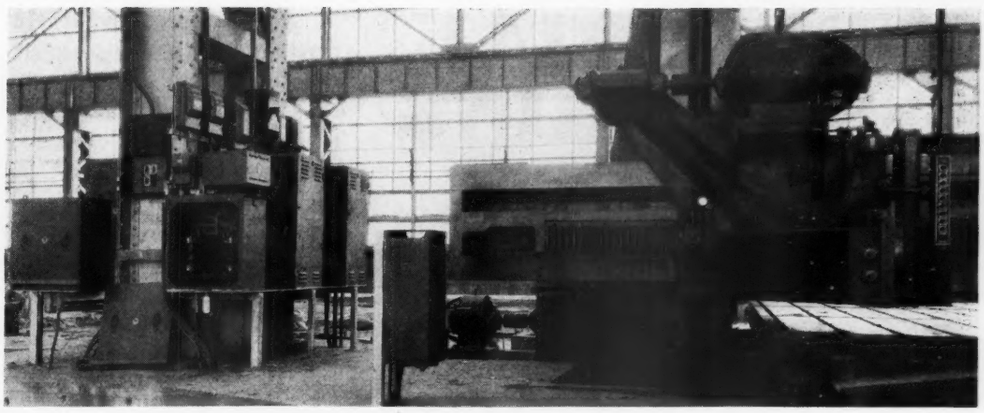
Overhead circuits to the various buildings were considered undesirable, inasmuch as they would be exposed to mechanical hazards and short circuits. Hence, all tie lines between the substations, and all feeders leading from these, are carried underground. Approximately 90,000 lin. ft. of underground duct, served from 28 manholes, was installed for the power circuits. The conduits range from four ducts to 40 ducts cross-section, with a manhole about every 350 ft. The ground in which the ducts are laid is always damp, owing to a nearby river; hence, there should be no difficulty in radiating the heat developed in the cables. Every circuit is tagged with a number, which it carries throughout its length.

To handle the present plant load there are, in addition to the d.c. feeders, serving cranes, chiefly, 18, 440-volt three-phase 350,000-circ. mil feeders and 20, 220/ 110-volt 250,-000-circ. mil lighting feeders. Of these feeders, 21 serve the foundry and 17 the machine shop and service building. Provision has been made for 40 more power and lighting circuits to take care of future requirements. The use of such a large number of circuits will help to avoid the necessity for bulky feeders, and will make it easier to meter the power by departments.

Where the underground feeders terminate at the walls of the different buildings, there are manholes connected with conduit risers which run about 16 ft. up on the inside of the wall. From this point open wires, with slow-burning insulation, branch out from potheads and continue to the roof girders, where they are connected with similar open wires spanning the entire building. These cross-feeder wires are supported on each side of the building by anchors, wood insulators and clamps, and by intermediate insulating supports. The cross-feeders, in turn, are connected to 350,000-circ. mil longitudinal feeders similarly supported and extending down each bay to their respective branch service cabinets and inclosed

magnetic contactors. The latter are usually mounted on or around the columns above the crane rails. The contactors are controlled by toggle or safety switches from the floor level, depending on the service.

This arrangement of feeders and branch circuit contactors is used for all distribution in the foundry and machine shop, and has several advantages, such as, all circuits are readily accessible; taps can be made on feeders at any point; all branch circuit contactors are removed from working spaces, but are accessible from elevated walkways along the column lines; feeders to the crane rails or apparatus on the floor can be run down the columns.

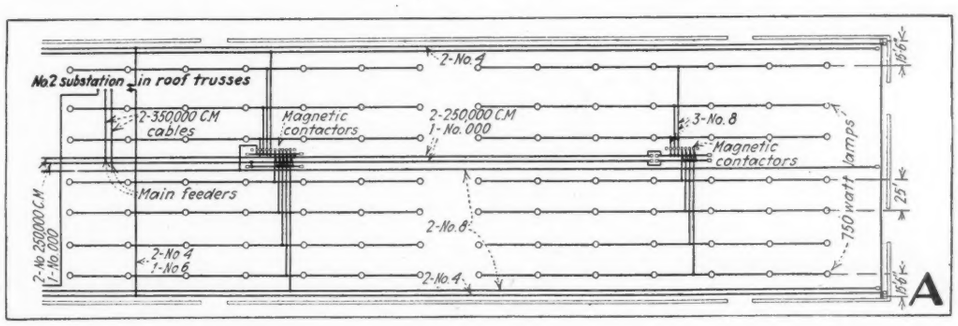


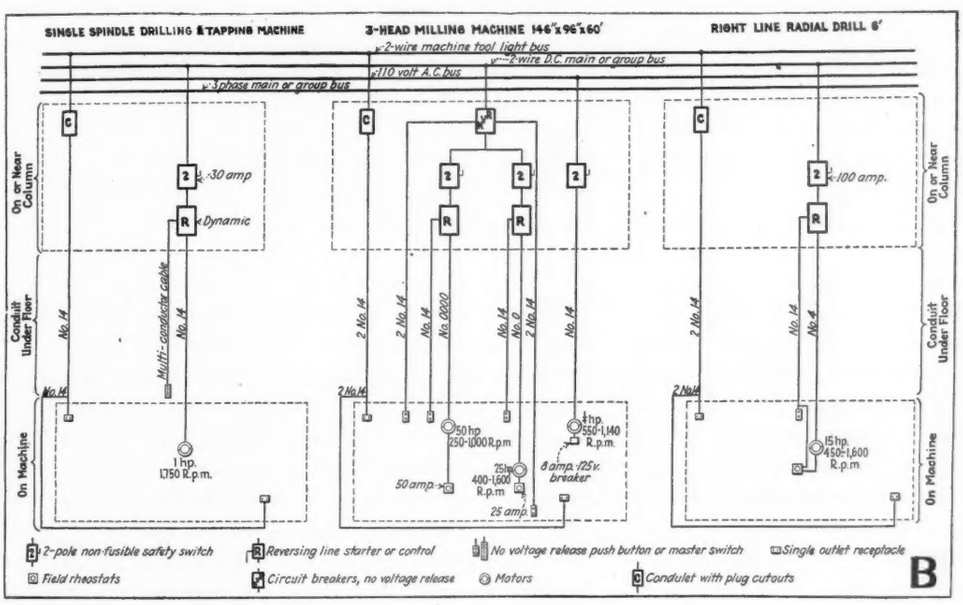
How controls for machine tools are grouped around the building columns.

No attempt was made to estimate exactly the power required by each motor and section of a plant in order to determine the load centers and wire and switch sizes. Past experience has indicated that certain amounts of power are required for different operations, but if only these requirements are met, they are soon exceeded. Consequently, when laying out the distribution system the average requirements for different operations were multiplied by two or three, to provide for future expansions.

In the machine shop, the larger machines are set diagonally along the center line of the building; hence the method of distribution we are using is particularly convenient because branch circuits can be run along between the central columns over the machines and the contactors mounted near the upper parts of the column. Individual machine contactors and control equipment is mounted on or near the lower portions of the columns. The circuits coming down the columns, as well as those from the control equipment to the machines, are run through conduits.

The lighting system in the foundry and in the machine shop comprises 500- or 750-watt lamps in aluminum reflectors set on 22½-ft. centers from 46 to 48 ft. above the floor. The lamps are connected in groups of seven, and each group is controlled by toggle switches mounted at the floor level, which actuate contactors mounted near the roof.





Distribution system (diagram A) for machine shop lighting; B, power supply and type of controls used on three major machine tools. The controls are mounted on building columns, or nearby. They are supplied by feeders that come down the columns in rigid conduit and are tapped onto open wires supported from the roof trusses and running lengthwise through the machine shop.

INDUSTRIAL ENGINEERING

L. C. MORROW, *Editor*

Vol. 89 JANUARY, 1931 No. 1

Happy New Year—and Here's How to Get It

INDUSTRIAL ENGINEERING wishes you a Happy New Year. It is the same old wish, but more sincere than ever because of the somewhat unhappy year all of us have just gone through.

It's well enough, and maybe best, to let such a wish stand for itself. Morals tacked on to stories and preaching of any kind are not likely to be popular. Yet here is a special occasion—perhaps an added constructive suggestion will give emphasis to the wish.

This suggestion is none other than that you can the more speedily bring about the fulfillment of our wish if you will give your active efforts to the obtaining of greater net profit for your particular industrial unit—your plant.

Do you but figure out the means and recommend the modern equipment that will make those increased net profits possible. Prove that the expenditures are necessary—being made they start the circle of prosperity which will mean a universal Happy New Year.

Cheap Tools and Careless Workmen

WHEN we think of safety work in industrial plants it is likely to be associated with proper guarding of machinery, providing sufficient illumination to prevent stumbling, and other well-known measures for reducing hazards. Important as such measures are, they do not by any means reach all sources of accidents and injuries. Commonly used hand tools, for example, are a very frequent source of injuries which are often serious—sometimes fatal.

A recent study made by the Bureau of Industrial Hygiene of the New York State Department of Labor showed that in that state 7,389 persons received compensation amounting to $1,574,455 in one year for injuries from hand tools. The lowly hammer caused nearly one-third of all permanent injuries, and more than 1,000 temporary cases. Knives come next in line, with wrenches, hatchets, chisels, crowbars, screwdrivers, files, and so on swelling the sorry list of injuries to every part of the body.

Analysis of a considerable number of accidents disclosed that carelessness or ignorance in using the tools involved played an important part in causing these accidents. Tools that were in poor or bad condition, defective, poorly made, or misused, were direct or contributing factors in another large number of cases. All of which means that a great many of these mishaps could have been avoided in one way or another.

For the plant engineer the practical application of these facts lies in such attention to the tools employed by his men and the manner of using them as is necessary to insure the greatest measure of safety. Working oftentimes under the stress of emergency conditions, maintenance men are frequently called upon to use all sorts of tools under all sorts of conditions—all circumstances that make accidents easy.

Many of the hazards can be reduced materially by insisting that only the best tools be used—cheap tools are likely to be the most expensive in the long run—that they be kept in first-class condition, and that inexperienced workmen be given proper instruction in their use. The cost will be cheap insurance against regrettable and expensive injuries.

New Form of Equipment Review

FOR the past two years approximately 60 per cent of the editorial section of *Industrial Engineering's* January issue has been devoted to an illustrated review of the equipment described in the Equipment News Sections of the twelve issues.

Increased recognition and broadening of the function which the publication serves has made it imperative that we now use the greater part of the space hitherto used for the review for the publication of the same type of educational, practical article that makes up the bulk of the normal issue.

Hence the form of the review has been changed. This feature now consists of a classified index of the equipment described in *Industrial Engineering* during the year 1930. It will be found on pages 51 to 54, inclusive.

The practice of filing issues of *Industrial Engineering* after they have served the current needs of the reader is not uncommon. A file of the year's issues, plus the equipment index herewith made available, constitutes a review of the year's equipment, yet provides greater detail than is possible when the descriptions are briefed and are compressed into a single issue.

A separate copy of the Equipment Index may be had upon application to the editor if it is

desired for filing with the twelve issues of 1930. An advantage of using the separate copy will be that the January issue of 1931 will be left free for use in beginning the file of 1931 issues.

In the Welding Spotlight

THAT welding is industry's child by adoption, to be brought to full stature only through exact knowledge of fundamentals, was emphasized at the Sixth Welding Conference held recently at Purdue University.

From a symposium of thirteen papers presented before an attendance of 218, plus a limited number of demonstrations, one could easily trace its history, and could make some predictions as to its future, to-wit: The passing of the itinerant welder is foreseen; the welder of tomorrow must be a specialist, ranking with the machinist, millwright, and electrician.

Welding is being studied under the laboratory spotlight more intensively than ever, because, in addition to being an effective maintenance tool, it is fast becoming an important production tool. With the advent of alloy steels and other non-ferrous alloys, the welder needs the services of the laboratory, with its facilities for the study of crystal structure and radio-graphic means for the visual analysis of welds. In the laboratory it is found what causes a poor weld, and a technique of prevention is developed. This technique is passed on to the welders. It is predicted that the day is not far away when laboratory tests will be applied in the field to every weld.

Open the Circuit Before Replacing Large Lamps

NUMEROUS complaints have been made by plants using large lamps that the lamp base sometimes sticks in a socket and cannot be removed without taking the socket apart. As a rule either the manufacturer of the socket or the lamp is blamed.

The cause can be traced in most cases not to faulty lamps or sockets, but to the fact that a large lamp is screwed into the socket without first opening the switch. When several lamps are controlled from the same switch, the maintenance man, when replacing a lamp, does not want to turn out the other lamps on the same circuit. Evidently a small arc is formed and some of the solder is melted when the base eyelet first touches the center contact of the socket. If the contact is bright and clean the molten solder adheres to the lamp contact, fusing them together.

With lamps having arc-welded contacts the copper lead-in wire is welded to the base eyelet. Such welded contacts are just as prone to fuse, and are more difficult to release than soldered contacts.

Perhaps it will be possible in the future to design lamp bases and socket contacts with which such fusing will not be possible. In the meantime it will be well to instruct plant electricians not to put lamps, especially the larger sizes, into live sockets.

Index to 1930 Industrial Engineering to be Ready Soon

UPON application to the Circulation Department, 520 North Michigan Ave., Chicago, you may have a copy of the index to the contents of the 1930 volume of *Industrial Engineering.* The index is arranged to show the articles under "subject" headings and contains cross references wherever they will be of assistance. There is also an authors' section, wherein the titles of articles are listed under authors' names arranged alphabetically. The index will be available about Feb. 1. Early application will assure prompt mailing.

Volume Eighty-Nine

WITH this issue we begin Volume 89 of INDUSTRIAL ENGINEERING, a consolidation of several publications. *Electrical Review,* begun in 1882 as the *Review of the Telephone and Telegraph,* with George Worthington as editor, was the founder paper. It absorbed *Western Electrician* in 1908, *Electrocraft* in 1912, and *Electrical Engineering* in 1928.

The McGraw-Hill Publishing Company purchased *Electrical Review* in 1922 and changed the name, first to *Electrical Review and Industrial Engineering,* and then to *Industrial Engineering.* D. H. Braymer became editor in 1922 and was succeeded in 1926 by G. A. Van Brunt, now electrical editor. In December, 1927, *Industry Illustrated* was consolidated with *Industrial Engineering.* The present editor took charge in November, 1928.

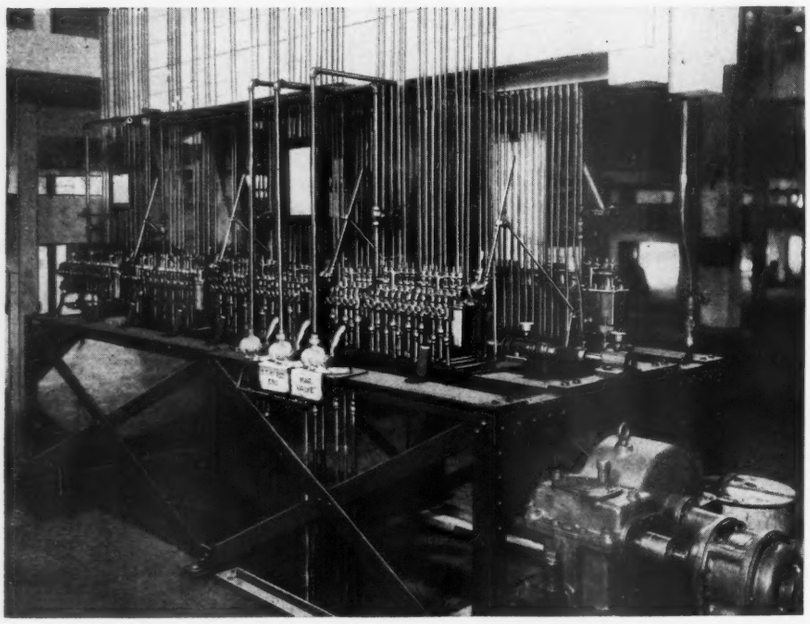
The staff of *Industrial Engineering* consists of: L. C. Morrow, editor; Wilbur A. Beck, managing editor; G. A. Van Brunt, electrical editor; E. P. Sweeney, assistant editor.

LUBRICATING SYSTEMS

Pressure Types

By FRED H. LOW
Mechanical Engineer

Third article of a series. The fourth will appear in an early issue.



Courtesy Hills-McCanna Company

Fig. 17—A battery of force-feed lubricators comprising a network of 102 feeds handling the distribution of ten different grades of oil.

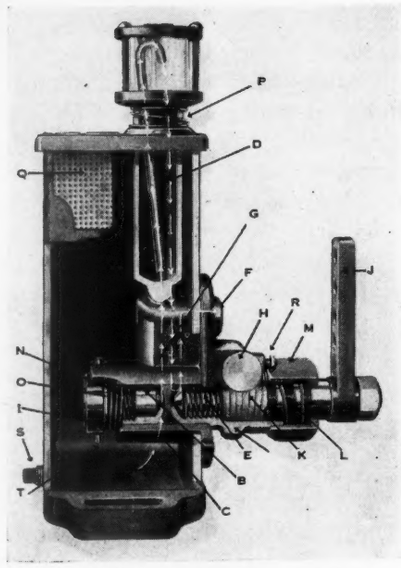
A UNIQUE installation, Fig. 17, shows what can be done in the way of labor saving with centralized pressure systems. Not only is labor reduced to a minimum, but by handling the oil in a room closed off from the rest of the plant, the possibility of dirt getting into the system is avoided.

This system includes 102 separate feeds which run throughout the plant of the Long Bell Lumber Company, Long View, Wash. Distribution of ten grades of oil is made through 7,000 ft. of ⅛-in. pipe. The main storage of oil consists of ten underground tanks of 420-gal. capacity each. Compressed air forces the oils to ten 6-gal. overhead tanks from which they flow by gravity to their respective force-feed lubricators.

Where only a single feed is required, the unit shown in Fig. 18 may be used. The tapered rocker shaft *A*, rocking back and forth, carries the oil from the oil bowl to the pump outlet. Pumping is done by means of two screw plungers, one being operated at each end of the rocker shaft. There is a wall near the center of the rocker shaft separating the two chambers in which the plungers operate. The metering plunger *B* draws the oil from the bowl at the intake *C* and forces it up through the sight feed into the sight-feed cup *D*, which acts as a receiving chamber for the plunger.

From the sight-feed cup the oil is drawn into the pressure chamber from which it is forced through the pump outlet *F* to the parts to be lubricated. The pump barrel *G* furnishes a tapered seat for the rocker shaft, also a support for the regulating screw *H;* the pumping unit is thus made entirely independent of the oil bowl and may be taken out bodily.

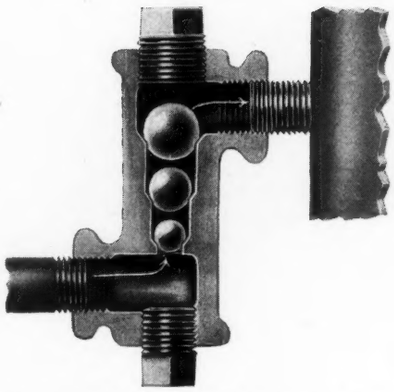
Operation of the metering plunger is effected by means of the taper pin *I* which, by means of the rocking movement of the rocker shaft, is brought into contact with a fork on the end



Courtesy McCullough Manufacturing Company

Fig. 18—A screw-type valveless pump that adjusts itself to all grades and conditions of oil.

of the pump barrel. The pressure plunger is operated by the rocking movement of the pump arm *J*. Friction of the packing *K*, together with the movement of the pump arm, operates the rocker shaft. Tension of the heavy spring *L* keeps the packing



Courtesy McCullough Manufacturing Company

Fig. 19—A three-in-one check valve.

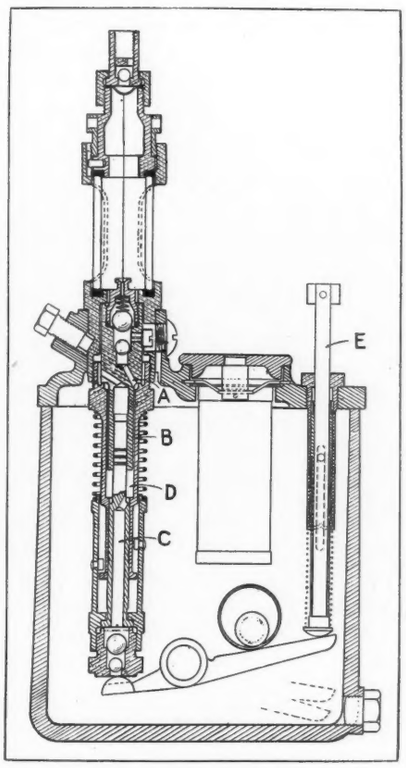
seated and the packing nut *M* from working loose. The adjusting spring *N*, together with the friction cone and cup *O*, control the fit of the rocker shaft in its seat. Thus the pump automatically adjusts itself to all grades and conditions of oil, and permits accurate handling at any temperature. When the oil is warm and thin the rocker shaft is held into its seat so that it is just an easy running fit, but when the oil gets cold and thick the rocker shaft automatically backs out of its seat just enough to allow for the difference in viscosity.

This self-adjusting mechanism also relieves the driving parts of all unnecessary strain, making the pump easy to operate and at the same time providing an automatic take-up for wear.

Sight feed is used constantly and every drop of oil that passes through the glass is on its way to the bearing or part to be lubricated. Because the glass is located on the top of the pump the feed may be observed from any point. Regulation of the feed is effected by turning the regulating screw. Adjustment can be made to handle any number of drops per minute within the capacity of the pump. A locking screw *R* holds this regulating screw in place.

Oil is poured into the reservoir through a strainer. A sump for catching water and foreign substances that may have gotten into the bowl is provided in the bottom of the reservoir; also a warming chamber *T* is provided to be used when conditions make it necessary.

With each pump is included a check valve, Fig. 19, to be placed in the oil line to prevent steam or water from backing into the system. It consists of three balls of different diameters seating one above the other in a tapered passage. To clean the valve it is necessary to remove both plugs, push out the balls, and draw a cloth through the taper. If the lead is to a steam line, as when lubricating steam cylinders, the seat may be cleaned by removing only the bottom plug, raising the balls with a stick, and allowing the steam to blow by.



Courtesy McCord Radiator & Manufacturing Company

Fig. 20—Vertical, differential plunger-type device for timed lubrication. Without making any changes inside the reservoir these lubricators may be driven by means of a ratchet, an internal spur gear, a worm, or a lever.

Another equipment suitable for timed lubrication is illustrated in Fig. 20. The pumps are of the vertical, differential plunger type. The plungers are ground accurately on both diameters, the lower part working in an extension of the pump barrel. The upper or smaller part is accommodated in a floating cylinder, combined with a delivery valve cage, thereby insuring accurate alignment under all working conditions. This method of pump construction enables small uniform quantities of oil to be pumped against high pressure at all speeds.

Although the upper part of the plunger is always ¼ in. in diameter, the lower part is furnished in three sizes, having ⅜-, 5/16-, and 9/32-in. diameters. The smaller sizes are for use where the number of pump strokes per minute is high and where very small quantities of oil are fed.

Oil-sealing chambers, preventing the ingress of air into the pump chambers, are arranged both at the top and bottom ends of the differential plunger, thereby obviating the use of packing.

Each pump is operated by means of a separate cam fixed on an operating shaft and engaging with a lever which is mounted on an idler shaft. The return or suction stroke is effected by means of a spring.

On the downward or suction stroke, oil is drawn through the suction valve and up the hollow plunger *C*, into the pump chamber *D*. On the upward or delivery stroke, the suction valve closes automatically and oil is forced from the pumping chamber up through the annular space *B*, through the port *A*, and thence through the double ball-check delivery valve and the oil nozzle into the water chamber of the sight-feed fitting to the top of which is attached the delivery pipe.

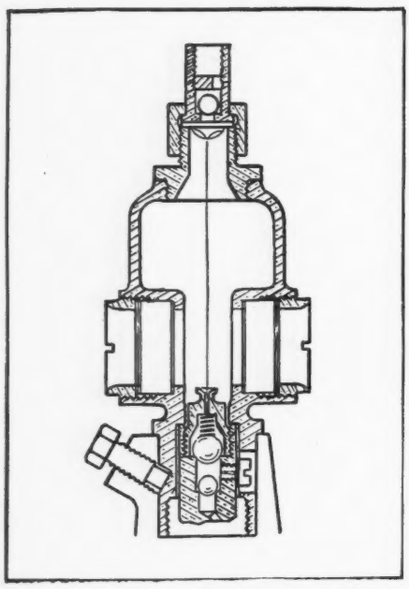
The stroke of each pump is adjustable, and is regulated by turning the flushing rod *E*. Hand flushing is achieved by depressing and releasing this rod. The jumping action of this rod gives an indication of the pump stroke when the lubricator is working.

There are two types of sight-feed fittings—the tubular type shown in Fig. 20, which is used on all pumps required to feed against pressures up to 750 lb. per sq. in.; and the bull's-eye type, Fig. 21, where pressures exceed that amount. A fine wire leading from the nozzle to the outlet acts as a guide for the drop of oil, insuring that it goes directly through the fitting. In each case the fitting forms part of the pump unit and is mounted on the cover where it is easily seen.

It is sometimes assumed, because there is a considerable pause between one drop of oil and the next leaving the nozzle at the sight-feed, that the bearing is without oil during that period. A little study will show, however, that this is not the case. If it takes ten strokes of the pump to build up on the nozzle a drop of oil sufficiently large to leave the nozzle and pass through the water, it follows that at each impulse of the pump a tenth of a drop will have to be discharged from the bearing fitting, otherwise the piping or the bull's-eye fitting would burst.

Spring-loaded, ball-check valves, Fig. 22, are furnished for the terminal connection of each feed. They are made for ⅛-in. iron or brass pipe or for ¼-in. tubing, using compression fittings.

To give the reader some idea of the size of these equipments I quote the capacities corresponding to the



Courtesy McCord Radiator & Manufacturing Company

Fig. 21—Sight-feed fitting for pressures above 750 lb. per sq. in. A fine wire leading from the nozzle to the outlet acts as a guide for the oil.

number of feeds offered by one manufacturer:

Number of Feeds	Approximate Reservoir Capacity
One, two, three, four	6 pints
Five, six, seven, eight	11 pints
Nine, ten, eleven, twelve	16 pints
Thirteen, fourteen, fifteen, sixteen	21 pints

Another unit built by this manufacturer is shown in Fig. 23. In it a cast-iron reservoir carries one or more independent removable pump units actuated by motion transmitted through an operating shaft traversing the whole length of the lubricator.

The pump unit is made of brass and contains two plungers *X* and *Y* connected at the top of a driving yoke *Z*. Vertical motion of the plunger is obtained by the stroke shaft *C*, driven by the eccentric *B*. This eccentric is revolved by a ratchet mechanism located at one end of the interior of the reservoir and driven by a shaft *D* extending through a stuffing box to the exterior.

On its upward stroke the measuring plunger *X* draws the oil from the reservoir through the suction tube, and on its downward stroke delivers the oil to the sight feed *E*, from which it is drawn by the delivery pump *Y* and delivered to the point to be oiled.

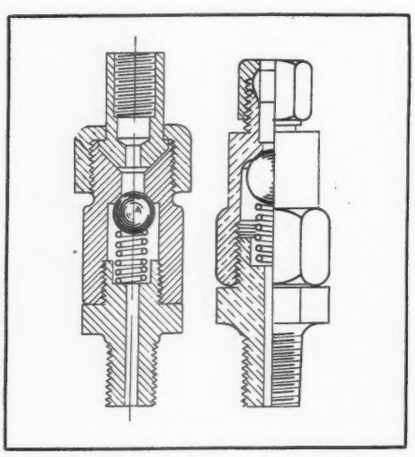
A hand crank is attached to the shaft on the opposite end from the driving mechanism to permit hand flushing, and when desired two-compartment tanks may be included to handle different grades of oil.

The amount of oil delivered is dependent entirely upon the length of the stroke of the metering piston, which is regulated by raising or lowering the adjustment nuts *F* shown just above the driving yoke *Z*. The lower these adjusting nuts are set the longer the stroke, resulting in less lost motion of the driving yoke and, consequently, a larger amount is delivered.

A unit for hard service out-of-doors, such as on locomotives, is illustrated in the section drawing, Fig. 24. The pumping mechanism, as shown, is located on the side of the oil reservoir and is completely inclosed, but easily accessible through removable plates and covers.

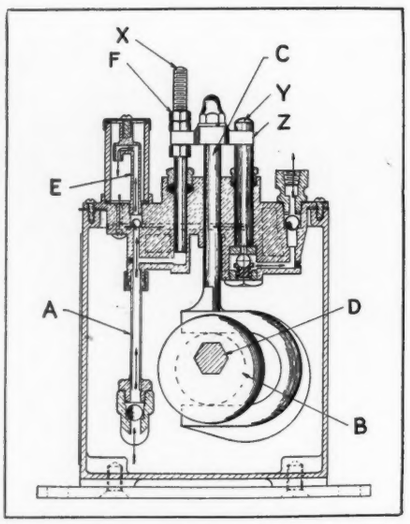
Reciprocating motion, carried through a ratchet, causes the eccentric shaft *A* to revolve. The eccentric imparts a vertical reciprocating motion to a header carrier *B* which extends the entire length of the chamber and in turn drives the pump sleeves indicated by *C*. Fig. 25 shows a section of the pumping mechanism, which consists of a header traveling through a vertical reciprocating cycle, two plungers *A* and *B*, both of which are stationary, and ball checks and their retainers.

It will be noted that the plunger *A*



Courtesy McCord Radiator & Manufacturing Company

Fig. 22—Sectional views of spring-loaded terminal check valves.



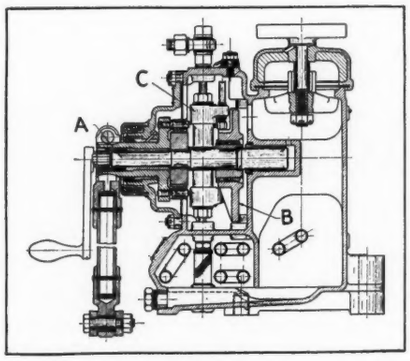
Courtesy McCord Radiator & Manufacturing Company

Fig. 23—Cross-sectional view of a force-feed lubricator in which the individual units may be removed without affecting the action of the others.

is larger than the plunger *B*, having actually twice the displacement. On the suction or upward stroke, oil which has been filtered through the strainer *C* is drawn through the ball check *D* and the plunger passage *E* to chamber *F*. On the down stroke the oil is forced through the ball check *G*. Plunger *B*, having only half the displacement of plunger *A*, forces only half the oil through the passage *H* and into the delivery tube. The balance from chamber *F* is drawn into chamber *I* and remains there until the header reverses its cycle of travel. At this point the oil remaining is forced on the upward stroke through the passage *N* and is likewise discharged into the delivery tube.

Feed adjusting screws are concealed so as to make tampering difficult. Access is gained by swinging the two protecting plates backward. These plates are provided with holes so that they may be sealed in position. Screw feeds *J* may be individually adjusted to deliver the desired quantity of oil, and when once set a pawl prevents their displacement.

Although practically all other pressure oil lubricators are equipped with glass oil gages, this unit uses a measuring rod graduated in pints to indicate the amount of oil in the reservoir. When not in use the rod is screwed into the cover. This type of gage is particularly satisfactory for the conditions under which the lubricator is designed to operate, as it is unbreakable and there is no chance of leakage. The lubricator is equipped with



Courtesy Detroit Lubricator Company

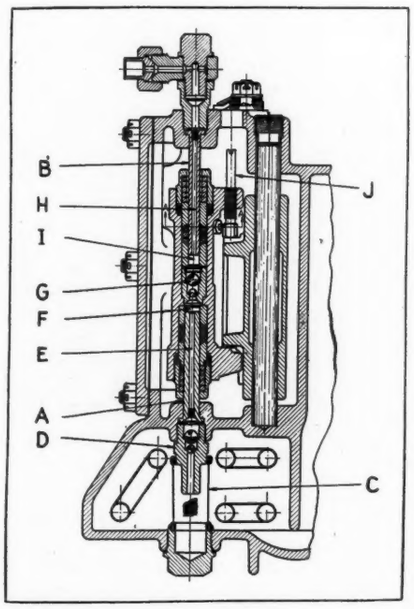
Fig. 24—Sectional details of a mechanical lubricator for out-door service.

a hand crank for priming and flushing, also a thermostatically controlled steam heater as shown by Fig. 16 in the preceding article.

An equipment employing the hydrostatic principle for lubricating steam cylinders is shown in Fig. 26. Steam at the boiler pressure enters the lubricator at *A* and condenses. This condensate fills the condenser to the point *C*. Since the condenser is connected to the oil reservoir by the water passage *B*, and with the water valve *G* open, water enters the reservoir and fills all the space not occupied by the oil. Because of its lower specific gravity the oil floats on the water. The weight of the column of water exerted under the body of oil in the reservoir forces the oil, as indicated by the arrows, down the passage *J* and past the regulating valve *F*, drop by drop into the sight-feed chamber.

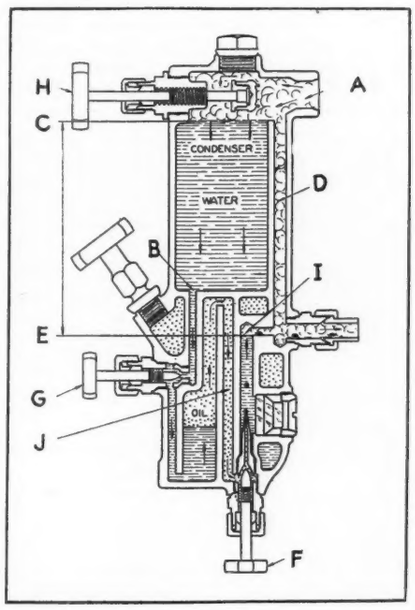
Condensation from the equalizing passage *D* keeps this chamber filled with water. Drops of oil float to the top of the water and are carried by the circulation of steam from the equalizing passage to the point of lubrication.

A unique automatic pressure system designed for supplying oil to the bearings of automobile chassis is shown in Fig. 27. The pumping mechanism, which is of the inertia type, is contained in the oil supply tank, the pump being submerged in the oil at the bottom.



Courtesy Detroit Lubricator Company

Fig. 25—Pumping mechanism of the lubricator section shown in Fig. 24. By the use of pistons of two sizes in the same unit oil is fed to the bearings on both up and down strokes of the pump.

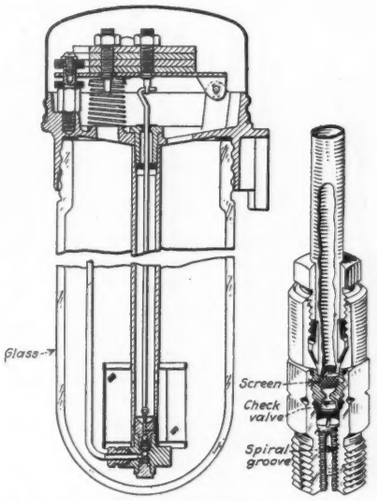


Courtesy Detroit Lubricator Company

Fig. 26—In this device, shown in cross section, the operating principle is that of a column of water exerting a pressure upon the oil in the reservoir in such a manner as to force the oil past one or more regulating valves and thence to the point of delivery.

At the top is a spring-balanced weight which moves up and down with the vertical motion of the car. This motion is transmitted from the weight to the pump by means of a rod. Pumping action is said to be produced with the slightest movement of the car springs, such as occurs frequently on the smoothest roads.

Owing to its frequent operation during the time the car is in motion, only a small quantity of oil need be delivered at each pulsation of the pump, permitting the use of a piston of small diameter. Since the weight employed is relatively heavy, pressures of from 100 to 200 lb. per sq. in. are obtained in this system.



Courtesy Alemite Corporation

Fig. 27—Section through a pumping unit that depends for its operation on the vibrations or oscillations set up in it. Details of an outlet fitting used in the same system also are shown.

Completely surrounding the pump is a screen through which the oil must pass before entering the pump by way of a port uncovered by the piston on its upward stroke.

The downward stroke of the piston forces the entrapped oil through a ball check into the feed line. The quantity of oil delivered may be controlled by adjusting the depth of the piston stroke by means of a set screw which secures the piston rod to the weight.

Oil is distributed to all of the bearings through a single pipe line. Outlet fittings provided at the points of application strain and meter the oil as it passes to the bearing. In these devices the oil, after being strained through a wire mesh, passes through a check valve and thence through a helical groove between the screw and the body of the fitting.

By moving the screw in or out the length of this passage may be varied, thereby controlling the flow of oil, the resistance to the flow varying directly as the length of the passage.

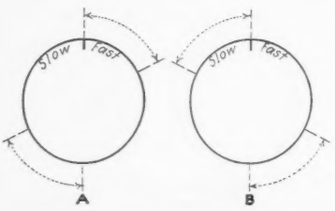
Such a system is fully automatic, starting and stopping with the car and feeding oil in direct proportion to the working of the chassis parts as governed by road conditions.

QUESTIONS *and* ANSWERS

Please submit answers promptly. We expect to publish no answers later than the second issue following the appearance of the question. Selection will be made on the basis of quality, but answers first received have the best chance of being used.

What Is Wrong with This Synchroscope?

We have had a G.E. M 3 synchronism indicator in use for six years that has recently given trouble. Our power supply consists of one 750-kva. generator, turbine driven, and one 350-kva., belt-driven generator. Both are 60-cycle, 110-volt machines. When synchronizing, as the incoming machine gets nearly in phase the needle of the indicator



jumps past the center mark on the dial. When the incoming machine is slow the needle swings as shown in diagram A; when the machine is fast the needle takes the position indicated in diagram B. It makes two jumps per revolution. I have connected a 50-watt, 250-volt lamp in series with the indicator resistance and the needle does not now jump so fast; the movement from the spaces shown in the diagrams is much slower, but still faster than elsewhere on the dial.

I shall appreciate it if someone will tell me how to remedy this trouble. **A. H.**

Selma, La.

Cause of Hot Armature Bearings

Out of about 700, 135-hp., 600-volt, street railway armatures there are two that give us much trouble due to repetition of certain defects—badly worn or hot armature bearings. These two armatures are never replaced in the same motor shells, and we have inserted new shafts, put in new coils, balanced them, and so on, but can not overcome the difficulty. These defects have continued over a period of seven years, and we can average only 1,000 car-miles per defect. What is causing this trouble, and how can we cure it?

Upper Darby, Pa. **C. S.**

Power Factor Rating of Synchronous Motors

I have been investigating the use of synchronous motors to improve our plant power factor, and have been somewhat puzzled by the fact that these motors may be rated 80, 90, or 100 per cent power factor. It will be very helpful to me if someone will explain just what this rating means and how it affects the choice of synchronous motors for power factor correction. If we decide to buy such a motor, how can I tell whether to use, say, an 80 per cent, or a 100 per cent power factor machine?

Baltimore, Md. **B. G.**

UNITY or 100 percent power factor synchronous motors have a direct-current field excitation designed to create a leading wattless current of sufficient magnitude to overcome the lagging wattless current of the motor, and cause it to operate at unity power factor. A motor of 70 or 80 per cent power factor rating has a field which is over-excited to create a leading wattless current of higher value than necessary to operate at 100 per cent power factor, thereby enabling it to make some correction in the power factor of the circuit.

The greater the leading component of the motor, the greater the value of the field current required; hence the design must be such as to take care of the increased current.

In the case of a 500-kva., 80 per cent power factor synchronous motor the effective power is $500 \times 0.8 = 400$ kw. The motor will also furnish $\sqrt{500^2 - 400^2} = 300$ leading reactive kva. This leading reactive kva. is parallel to, but in opposition to, the lagging reactive kva. of the circuit and is the component that corrects the power factor.

Selection of a synchronous motor for a given application depends on such factors as size of motor required to drive the mechanical load, present and desired power factors, load in kilowatts, and so on. The economics of the case—how high it is justifiable to raise the power factor—must also be carefully considered. W. H. RUEHLIN.

Chief Electrician,
The Electric Auto-Lite Company,
Toledo, Ohio

Why Do These Belts Slip?

Considerable trouble is being experienced with the belts used on some across-the-line motors of 1- to 5-hp. rating. Heretofore we have had little real trouble with our belts. No change in quality has been made, so far as we know, but they do not seem to start the load so well with the new motors; after the motor is up to speed the belts apparently carry the load satisfactorily. Frequently a belt slips off when the motor is started. In practically all cases there is excessive slipping and squealing at the start. Two or three times the motor pulley has simply spun around and burnt the belt seriously. Belt dressing does not seem to help much. I shall appreciate it if readers will give me some suggestions on the cause of this trouble, and how to cure it. Is it likely to be due to a poor grade of belt?

Minneapolis, Minn. **G. McC.**

WHEN the changover from reduced-voltage starting to across-the-line starting was made no attention was paid to the fact that a line start motor subjects its whole driven mechanism to a tremendous impact at the moment of starting. The quality of the belts is unodubtedly O.K.; but line-start motors require heavier foundations, wider pulleys or gears, and wider and thicker belting. If the machine is direct connected be sure that all gears,

sprockets, etc., subject to the starting impact are strong and capable of withstanding this initial strain.

As a rough-"rule o' the thumb" I figure that the belt should be of the width required by a single-ply belt to transmit the desired horsepower with a compensator-started motor, but should be a *double-ply* for linestart motors. Be sure that the faces on both the motor and the driven pulley are amply wide. Do not use dressings to make the belt "stick" to the pulley to overcome slipping; use belts of the proper width and thickness.

CARL A. WAGNER.
Denver, Colo.

How Remove Fumes from Plating Tanks?

We are having trouble with the fumes and steam from our plating department. The tanks were formerly in a separate room, but are now in one corner of a large space used for manufacturing and assembly operations. The six plating and cleaning tanks are 10 ft. long, 3 ft. wide, and about 3½ ft. high. A hood slightly larger than the tank is suspended 4 ft. above each tank. These hoods, which are shaped somewhat like an inverted V, are connected to a large duct from which the fumes are exhausted by a fan. The acid-dip vats are grouped under a separate and somewhat larger hood. When the plating room was off by itself the workmen in it did not mind such fumes as escaped, but now the employees in the other departments are complaining. Can we alter the present system to remove the fumes more effectively, or will it be necessary to install a new system? If a new one is required, how should it be arranged?

Milwaukee, Wis. **F. J. N.**

I BELIEVE that the best way to overcome his trouble would be to install horizontally - slotted, rectangular ducts along the sides of the tanks. These ducts should increase the cross-sectional area toward the suction source, and be brought together in a breech connected with an exhaust fan or system. In the case cited, with tanks 3 ft. wide, an exhaust duct on the side opposite the working side of the tank might be sufficient.

These ducts should be made of either wood or sheet iron, depending on the corrosive action of the solutions. The slot or exhaust opening should be about 1½ in. high for the full length of the tanks; this opening should be blocked at intervals sufficiently to create a uniform suction the full length of the duct. Blocking should be done after the system is put in operation.

Systems such as described above are in use in our plant on nickel and chromium plating pickle, and hot solution tanks. In the case of our chromium plating tanks, we have tested the air in the room and found it to be entirely free from fumes. With the pickle tanks, our system of removing fumes will pay for itself in the saving in building upkeep. Previous to its installation in our plant no paint could be found that would withstand the steam and fumes, and the concrete ceiling in the room was gradually deteriorating. I believe that if F. J. N. will install this system he will find that the plating operations will not be objectionable in a manufacturing and assembly room.

The common trouble to be found with an exhaust hood installation is that any drafts in the room will tend to divert the fumes passing through the space between the tank and hood; with the slotted duct system the fumes are collected at their source.

EUGENE M. MARCHAND.
Bristol, Conn.

IN my experience with the ventilation of cleaning and plating tanks several designs of hoods have been used, of which two have been quite successful. In general, there are several items that should be taken into consideration when ventilating equipment of this nature. The fumes or steam rises from the surface of the liquid and it is the effectiveness with which we direct a current of air across this surface and pick up the fumes, to carry them into a collecting system, that determines the success or failure of the ventilation. We must eliminate all possible interference from currents of air around the room.

The hood described in the question could be made more effective by a few minor additions. Extend the sides of the hood down to the tank on all sides, except the one used for operation. Install a false roof in the hood, beginning 2 in. back from and 3 in. above the front of the hood, extending downward and back to a point 6 in. from the surface of the liquid and 6 in. from the back of the tank. It should be tight to the end inclosures. The ventilating action will then be a draft of air across the surface of the tank to the 6-in. opening. The vapors that escape the 6-in. opening will drift upward and into the 2-in. opening. The inclosed three sides form protection from the currents of air around the room. The most satisfactory results are obtained with a velocity of air across the surface of the tank of not less than 100 ft. per minute.

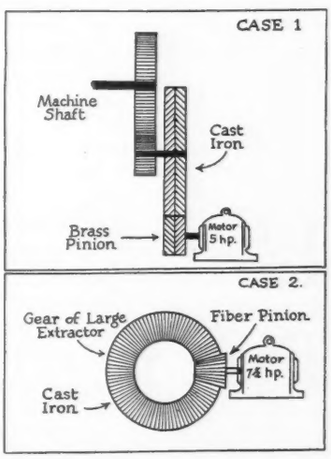
In case the fumes are heavier than air, or it is necessary to have the tank open on all sides for operation, a hood of somewhat different design is better adapted. It consists of a heavy-gage, sheet-metal cover, reinforced with angle iron, that completely covers the tank with the exception of an opening just large enough for operation. The cover is supported ¾ in. above the tank by spacers and extends out over the edge of the tank sufficiently far to form the top of a square collector duct that completely surrounds the tank. The outer side and bottom of the collector duct have to be formed and the bottom welded to the tank, which serves as the inner side of the duct. At each end of the tank the collector duct is connected to an exhaust system.

The important part of this hood is the small area used for operation. The smaller it is, the better. The collector duct should be figured large enough to handle a volume of air equal to a blast of 200-ft. velocity coming down upon the exposed surface of the liquid. The velocity in the collector duct should be not more than 1,000 f.p.m.

Lansing, Mich. J. M. NEWMAN.

How to Increase the Life of These Pinions?

Case 1: The brass pinion does not hold up at all, and makes a lot of noise. Apparently motor does not have end play.



Case 2: The fiber pinion wears out quickly. Alignment checks up O.K. Motor has ⅛ in. end play.

Can I get longer life from pinions made of other materials? If materials are not at fault what does cause these pinions to wear? **S.P.W.**

Woolrich, Pa.

NEITHER installation is ideal. On a motor pinion it is always desirable that the armature of the motor be permitted to float back and forth a trifle and find its center. If herringbone gearing is used, the herringbone pinion ties into the gear in such a way as to force its center to follow the center of the gear and this does not permit float on the armature and may cause a considerable thrust on front or rear armature thrust bearing. On the bevel gear job the same condition ap-

(Please turn to page 36)

Voltage Surveys and How They Are Made

By E. S. LINCOLN
Consulting Engineer, New York, N. Y.

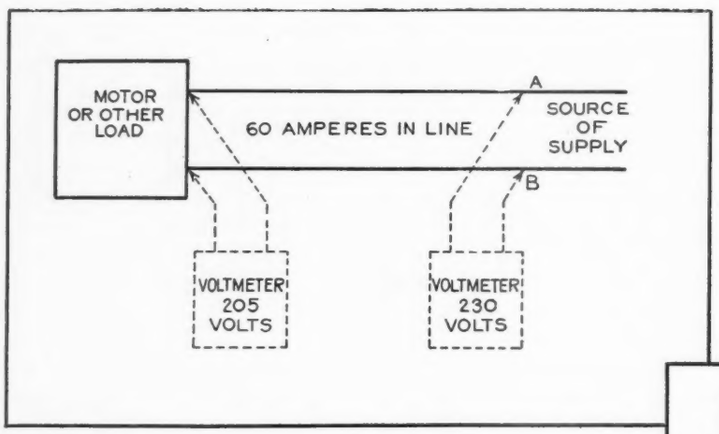


Fig. 1—Schematic diagram showing the two-voltmeter method of obtaining line drop. The loss in the conductors equal 60x25 or 1,500 watts (750 in each leg). Doubling the cross-sectional area of wire will cut the loss in half. The drop will be 6¼ or 12½ volts for both lines.

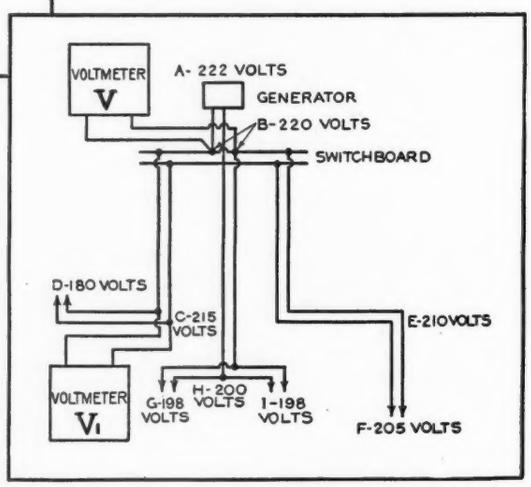


Fig. 2—Another application of the two-voltmeter method of making a voltage survey. The figures following the letters indicate voltage at the various points.

ELECTRICAL apparatus and machinery are designed by the manufacturers for operation on some specific voltage, and if the equipment is to function properly this voltage must be maintained within reasonable limits. However, the maintenance of this voltage at the terminals of electrical apparatus is possible only with a properly regulated supply and a carefully designed distributing system.

For electrical apparatus, especially incandescent lamps, the importance of the proper voltage maintenance is explained in Table 1.

Induction motors are affected by a 10-per cent voltage variation as shown in the table immediately above.

ABOVE NORMAL	BELOW NORMAL
Increases speed about 1 per cent	Starting torque decreased nearly 20 per cent
Increases starting torque	Power factor slightly improved.
Efficiency is slightly better at full load	
Efficiency is decreased at less than full load	
Power factor is decreased	

A voltage variation of more than 10 per cent from normal is very undesirable, and if below the normal motor rating, it will cause excessive heating and a great reduction in its efficiency.

Other equipment is affected by voltage variation, some of which will be discussed herein.

Direct-current motors — The speed of d.c. motors will vary with the supply voltage, increasing when it is above normal and decreasing when it is below normal. Speed variations will be slightly different for the various windings found in d.c. motors if the supply voltage varies.

In general, the efficiency of d.c. motors will decrease slightly with voltages below normal and increase slightly with voltages above normal. The current consumption of the motor will increase with sub-normal voltages which will also cause an increase in the losses in the system.

Synchronous motors—The speed of synchronous motors is affected by the frequency of the supply circuit and not by its voltage. In general, voltages above normal mean slightly higher efficiencies and conversely, lower voltages bring about slightly lower efficiencies. Low voltage also means low power factor values if the current is lagging and high power factor values if the current is leading. Voltages above normal cause an increase in the power factor if the current is lagging and a decreased power factor if the current is leading. In the foregoing cases the conditions exist when the excitation of the ma-

chine from an external source remains unchanged in value.

The speed of all a.c. motors is affected by the frequency of the circuit. This condition, however, is entirely under the control of the generating station and has nothing whatever to do with the distribution of electricity.

Heating apparatus—Improper voltage not only affects power and lighting circuits, but it is detrimental to electrical heating apparatus. Too high a voltage will cause burn-outs and too low a voltage will decrease the amount of heat furnished by the elements employed.

Electric heat is a function of current, and with a fixed resistance the current is proportional to the voltage of the circuit. A 3-kw. heater, designed to operate on a 220-volt circuit, will require a current of 13.63 amp., but if the voltage of the circuit drops from 220 to 210, this loss of 10 volts will cause a reduction of 136.3 watts in the apparatus, meaning that the heating unit will only consume 2863.7 watts. With some heating apparatus, the resultant loss in heat would not be detrimental, but in many it would be objectionable, especially if this loss should be further increased.

If this same heater had been designed to operate on a 110-volt circuit, the current requirement would then be doubled, or 27.26 amp.; and if it operated on a 110-volt circuit with a 10-volt loss, the wattage deficiency would be 272.6, meaning that the heater itself would only receive 2727.74 watts which would undoubtedly make its action very slow and unsatisfactory.

From the foregoing it is quite evident that a distributing system supplying electric heaters should have sufficient copper to reduce the voltage drop to a minimum.

Lighting system—By referring to Table 1, the importance of proper voltage supply for incandescent lamps will be seen. Voltages tests should be made when all lamps are on during the normal operation of the plant, and at the terminals of lamps required when only a few are burning.

In practically every case, it is low voltage that is the cause of lighting difficulties, but in some instances voltages above normal are experienced. Excessive voltage should be prevented at the source of supply, but if this is not possible compensation becomes necessary by the use of proper taps on transformers where alternating current is used and transformed, or with the use of higher voltage lamps.

Provided the proper voltage is maintained at the power house or service entrance, low voltage at the lamps may be due to several causes, some of which are as follows:

Wrong ratios in use of transformer taps.

Losses in the distribution system caused by insufficient copper in mains and feeders.

Use of too low a voltage for the amount of power being supplied.

To determine whether or not electrical apparatus is receiving its proper voltage, it is necessary to make actual measurements by means of a voltmeter at the terminals of the apparatus.

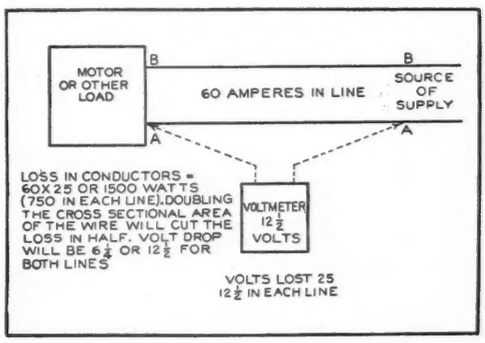

MOTOR OR OTHER LOAD
B
B
60 AMPERES IN LINE
SOURCE OF SUPPLY
A
A
LOSS IN CONDUCTORS = 60X25 OR 1500 WATTS (750 IN EACH LINE). DOUBLING THE CROSS SECTIONAL AREA OF THE WIRE WILL CUT THE LOSS IN HALF. VOLT DROP WILL BE 6¼ OR 12½ FOR BOTH LINES
VOLTMETER 12½ VOLTS
VOLTS LOST 25
12½ IN EACH LINE

Fig. 3—Schematic diagram of the one-voltmeter method of obtaining line drop. The loss in the conductor is found to be identical with that found in Fig. 1.

It is important to see that the proper voltage has been maintained at the terminals of transformers supplying the load or at the service entrance of the plant. If the voltage is correct at this point and sub-normal at the terminals of the apparatus, the trouble then lies within the plant. A "voltage survey" becomes necessary to determine between which points the decrease in voltage takes place.

It is the difference in voltage between two points on the same conductor that forms the basis of a voltage survey. The greatest difference in this voltage will occur when the current or load has attained its maximum value.

Low-voltage system—Either one of two methods may be used for making a voltage survey. The first is by the use of two voltmeters whose ranges are sufficient to measure the highest voltage of the system, as outlined in Fig. 1. One voltmeter is placed at the apparatus under test, the second is moved along the line to the switchboard of source of supply, thus determining the drop between the desired

TABLE I—EFFECT OF VOLTAGE VARIATIONS ON TUNGSTEN FILAMENT (OR MAZDA) LAMPS

Volts Per Cent	Candle-power Per Cent	Total Watts Per Cent	Watts Per Candle Per Cent	Current Per Cent	Life Per Cent
95	83.1	92.2	111.0	97.0	216
96	86.3	93.7	108.7	97.6	185
97	89.6	95.3	106.3	98.2	158
98	93.0	96.9	104.2	98.9	136
99	96.4	98.4	102.0	99.4	117
100	100.0	100.0	100.0	100.0	100
101	103.6	101.6	98.0	100.6	86
102	107.4	103.2	96.1	101.2	74
103	111.2	104.8	94.2	102.3	64
104	115.1	106.4	92.5	102.8	56
105	119.0	108.0	90.8	105.7	49
110	140.3	116.3	82.9	....	25

Note: The left hand column represents the percentage of voltage from normal at the lamp terminals.

When the rated voltage of the lamp is 100 per cent it gives its best service as will be seen by referring to the values in the above table. If the voltage is increased 10 per cent or a total voltage of 110 per cent, the candle power is increased 40.3 per cent, but the life of the lamp is only 25 per cent or ¼ what it would be with normal voltage. A reduction of 5 volts, or 95 per cent of the rated voltage, reduces the candle power of the lamp to 83.1 per cent but increases its life by 216 per cent, in other words, it will last twice as long giving less light.

points. Since this method requires simultaneous readings some communicating system must be devised so that the party in control of the test may record the voltage at each meter. Unless both meters have been calibrated to read alike any existing discrepancy between them must be known and corrections made accordingly.

This test is illustrated in Fig. 2 in connection with a two-wire 220-volt, d.c. distributing system in which *V* refers to the generator, or the source of supply. Represented at *V* is the switchboard, whereas letters *C* and *I* indicate motor locations. The figures shown with these letters refer to the voltage found on a test which was made by placing two voltmeters at points under test such as at *B* and *C*. In the case of a three-wire system both voltmeters are connected to the same conductors. At *B* the voltmeter indicates 220 volts, and at *C* the indication is 215 volts. The loss or drop is 5 volts between these two points. At *D* the voltage is found to be 180, which means a loss of 40 volts to the switchboard. Measurements between *C* and *D* show a drop of 35 volts which was traced to poor contacts in a switch and to an undersized long conductor.

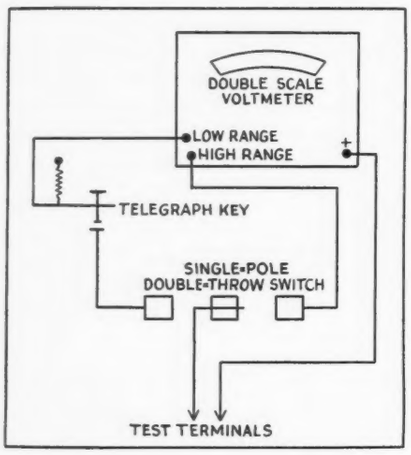


Fig. 4—A transfer switch is connected in the supply circuit to the meter. One side of the switch is connected to the high-range terminal, the other switch leg is connected to the low-scale terminal through a telegraph key. With the switch on the low-scale side the key is depressed momentarily to see if the pointer deflection is within the low-scale range.

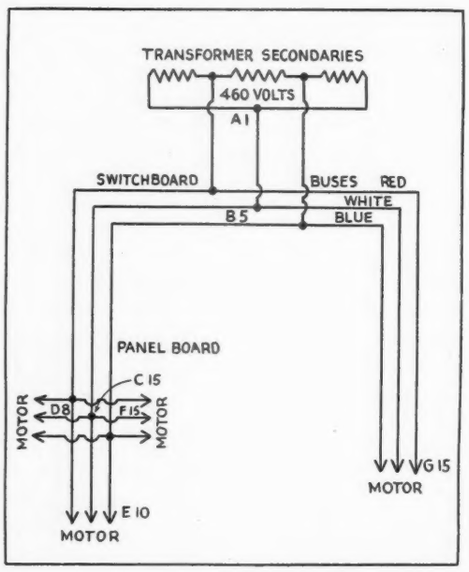


Fig. 5—A three-phase circuit or distribution diagram with indicated motor locations and voltage drop at each location. The voltage at the motor becomes the difference between the supply voltage and the sum of the drops intervening.

Graphic meters giving a continuous record for the variations at several different points could be used for this purpose, but their timing accuracy must be perfect or otherwise the results will not check.

The second method, shown in Fig. 3, employs a single, low-reading voltmeter having long leads which will reach between the various points to be measured.

When using a low-reading a.c. voltmeter, the question of current consumption of the voltmeter must be considered, which simply means that heavier wire should be used. However, No. 14 flexible cord will probably be sufficient if the length is not over 50 feet.

This method is best where the voltage fluctuates because only one instrument is read. As a matter of precaution the voltmeter used should have a double scale, the maximum scale having sufficient range to measure the highest operating voltage of the system. In Fig. 4 is shown a suggested method for protecting the low-voltage scale of the voltmeter.

To better illustrate this second survey method, refer to Fig. 5, which shows a three-phase, 440-volt distributing system. One terminal of the voltmeter was connected to the point *B*, the other terminal to point *C* on the same "white" conductor. The reading was 14 volts. The "red" and "blue" conductors were then tested in the same way and each showed a drop of 15 volts, making a total loss of 30 volts between these points. This same method may be applied to any part of the system. Other points shown in the diagram indicate the voltage as measured in the survey.

When using a single voltmeter, it is very often found that the voltage drop in each of the conductors in the same circuit will be different, owing to a difference in resistance of the individual conductors.

In taking the first reading the voltmeter connection should be made to the high-range scale. Under these circumstances, if the meter is connected across conductors of different polarity, no injury will result. In these measurements, the same conductor must always be properly identified before making a test.

Single-phase or three-wire d.c. system with neutral—A three-wire double-voltage system with a neutral conductor may be tested in the same manner as the systems previously described. If the load is fairly well balanced on each side of the circuit practically no current will flow in the neutral wire, and it may be disregarded. However, if the system is considerably unbalanced, then losses will occur in the neutral wire, which should be reduced by proper balancing. In general, it will be proper to treat the system as a two-wire circuit, using both outside conductors for the test.

High-potential circuits—For high-potential circuits the two-voltmeter method should be used by connecting the voltmeter to its proper potential transformer. The use of a single, low-reading voltmeter would be dangerous in case of a wrong connection to a conductor of opposite polarity—it might injure more than the voltmeter. In this work it is essential to use insulated connecting devices. As a rule, voltage drops in high-tension systems used to distribute power in industrial plants are small, and voltage survey is not so essential.

In a large plant, a voltage survey is often quite difficult to conduct, owing to the large number of wires and length of run and, at best, the work is somewhat tedious. The difficulty is increased, owing to the fact that continual variations are taking place where the voltage varies with different loads. Voltage survey should be conducted when the plant is operated at or as near full load as possible because the poorest voltage regulation, and especially low voltage

conditions, may be expected at that time. An ammeter should be placed in the circuit under test if the load is not known.

In order that a proper record of the voltage survey may be tabulated, it is suggested that a diagram of the connections be made, which will show all loads and conductor sizes. The indicated voltages and loads obtained during the survey may be recorded on the diagram from which the losses may be calculated.

Reducing losses in the distributing system—How important the results of a voltage survey may be will depend entirely upon how low the voltage drops are, the cost of power, and the length of time that these low-voltage conditions exist. It will also show the importance of having a properly designed distributing system.

With losses in a particular circuit as high as 1 kw., where the cost of power is 3c, the kw.-hr. charge would be 24c for an 8-hour day, provided the load was continuous. By doubling the cross section of the conductor this loss would be reduced to 12c a day. The change, however, should be figured on a basis of comparison to the yearly cost of supplying the losses.

In cases where losses occur intermittently and the cost of power is low, it undoubtedly would not pay to make any changes. However, in many plants, increasing the size of the conductors to decrease the voltage drops will not only pay for the cost of the change, but apparatus connected to the lines will operate more efficiently.

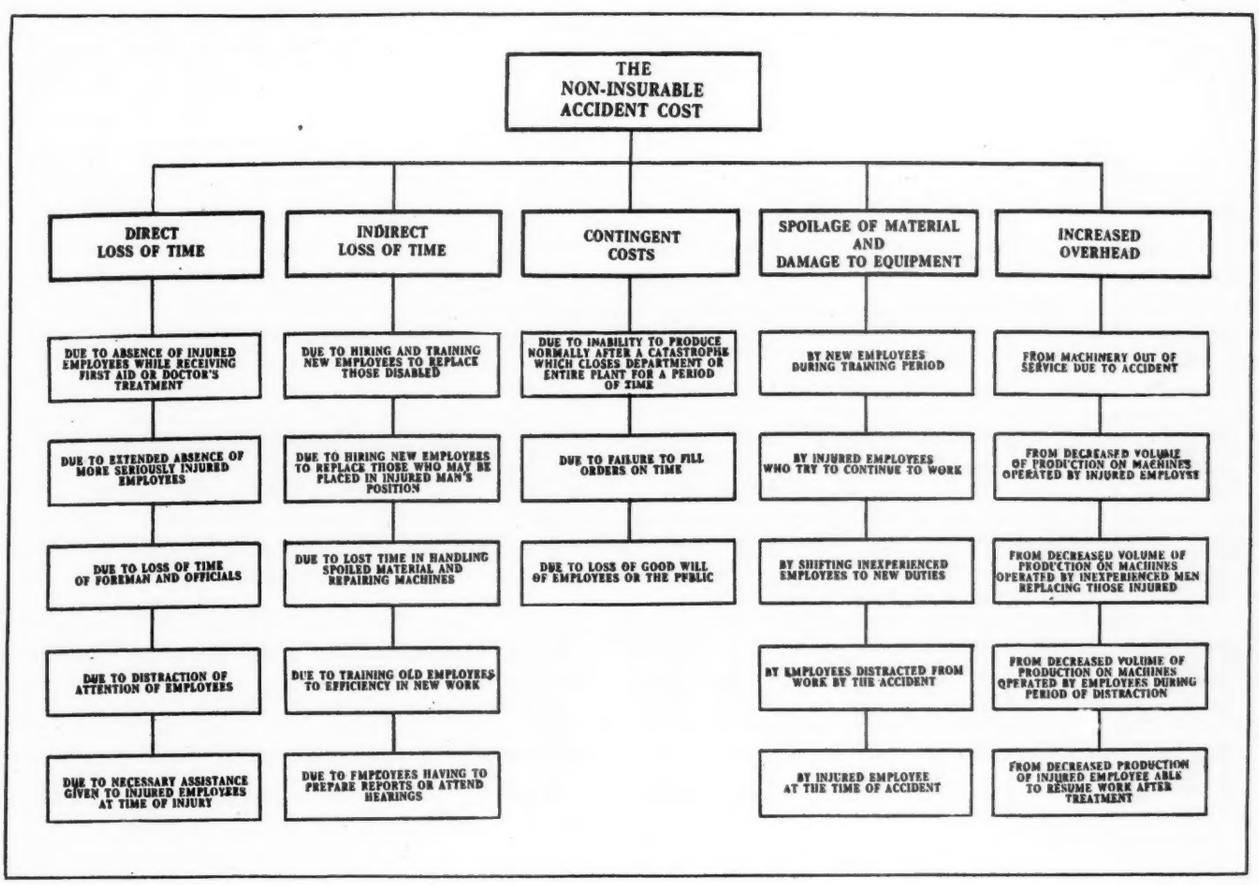
The amount of power lost in the system depends upon both the voltage drop and the current flowing. Unless one of these values is excessive, the actual loss in dollars and cents will not be very great.

To determine what these voltage drops mean in power, multiply volts drop by the current to obtain the watts lost. For example, if the voltage of a circuit is 440 at one end and 420 at the other, the drop is 20 volts or 10 volts in each conductor. With a current of 100 amp., the loss would be 2 kw. for both conductors. The loss in a three-phase system would be $1.73 \times 10 \times 100$ or 1,730 watts. Doubling the cross section of the conductors will cut this loss in half.

Accident Prevention

"AN accident is something gone wrong and it can result only from causes which have their effect over a far wider field than that of the immediate accident itself. An accident is only the spectacular evidence of some underlying maladjustment in the same way that a headache is only the alarm bell that calls attention to something that is wrong within."

This quotation is part of the foreword to the report, "Modern Methods of Accident Prevention," published by the Special Risk and Engineering Department of the Hartford Accident and Indemnity Company. The chart, also included in the report, illustrates some of the far-reaching effects of a simple accident in the shop.


THE NON-INSURABLE ACCIDENT COST
DIRECT LOSS OF TIME
INDIRECT LOSS OF TIME
CONTINGENT COSTS
SPOILAGE OF MATERIAL AND DAMAGE TO EQUIPMENT
INCREASED OVERHEAD
DUE TO ABSENCE OF INJURED EMPLOYEES WHILE RECEIVING FIRST AID OR DOCTOR'S TREATMENT
DUE TO EXTENDED ABSENCE OF MORE SERIOUSLY INJURED EMPLOYEES
DUE TO LOSS OF TIME OF FOREMAN AND OFFICIALS
DUE TO DISTRACTION OF ATTENTION OF EMPLOYEES
DUE TO NECESSARY ASSISTANCE GIVEN TO INJURED EMPLOYEES AT TIME OF INJURY
DUE TO HIRING AND TRAINING NEW EMPLOYEES TO REPLACE THOSE DISABLED
DUE TO HIRING NEW EMPLOYEES TO REPLACE THOSE WHO MAY BE PLACED IN INJURED MAN'S POSITION
DUE TO LOST TIME IN HANDLING SPOILED MATERIAL AND REPAIRING MACHINES
DUE TO TRAINING OLD EMPLOYEES TO EFFICIENCY IN NEW WORK
DUE TO EMPLOYEES HAVING TO PREPARE REPORTS OR ATTEND HEARINGS
DUE TO INABILITY TO PRODUCE NORMALLY AFTER A CATASTROPHE WHICH CLOSES DEPARTMENT OR ENTIRE PLANT FOR A PERIOD OF TIME
DUE TO FAILURE TO FILL ORDERS ON TIME
DUE TO LOSS OF GOOD WILL OF EMPLOYEES OR THE PUBLIC
BY NEW EMPLOYEES DURING TRAINING PERIOD
BY INJURED EMPLOYEES WHO TRY TO CONTINUE TO WORK
BY SHIFTING INEXPERIENCED EMPLOYEES TO NEW DUTIES
BY EMPLOYEES DISTRACTED FROM WORK BY THE ACCIDENT
BY INJURED EMPLOYEE AT THE TIME OF ACCIDENT
FROM MACHINERY OUT OF SERVICE DUE TO ACCIDENT
FROM DECREASED VOLUME OF PRODUCTION ON MACHINES OPERATED BY INJURED EMPLOYEE
FROM DECREASED VOLUME OF PRODUCTION ON MACHINES OPERATED BY INEXPERIENCED MEN REPLACING THOSE INJURED
FROM DECREASED VOLUME OF PRODUCTION ON MACHINES OPERATED BY EMPLOYEES DURING PERIOD OF DISTRACTION
FROM DECREASED PRODUCTION OF INJURED EMPLOYEE ABLE TO RESUME WORK AFTER TREATMENT

PLANT ENGINEERS' FORUM

Here is the sixteenth of a series of questions, each of which has at least two sides. A new question will be presented next month, and our readers' answers to previous questions also will be published. Write down your opinions and send them to the editor. Answers published will be paid for at an attractive rate.

Bonus for Maintenance?

Last month the Forum declared a holiday. Inventory of the year's work had to be taken and as many as possible of the 1930 discussions put behind us. With the new year we resume activities. Frank and Mrs. Fulleger are paying a New Year's Day call on Mr. and Mrs. George Shipman. While the ladies gossip about this and that George and Frank fall naturally into shop talk.

* * *

"I suppose that bonus checks were rather few this year, Frank. Or don't you still have the practice?"

"They were, George—and we do, but they are issued each month, if any, instead of at the end of year. Cuts no ice with us, though—seems they can't measure our maintenance work."

George smiled. "Guess that with your salary you don't need any."

"Oh, I'm not kicking on my salary," came back Frank. "I could use a little extra, of course, but what gets me is that the production people get paid extra for extra hard effort, while my men go along on the same old pay no matter how hard they work. The only extra is overtime, and I don't know that that pays the men in the long run."

"Well, maybe it's your own fault. Why don't you suggest that the maintenance department be paid regular wages plus a bonus?"

"But what kind of a bonus, George? How could you arrive at a figure?"

"Oh, I don't know; possibly on percentage of upkeep time to production time, or maintenance expense to value of production — I imagine that it could be worked out."

"Say, that *might* be done—with monthly bonus, too. We might even put repair jobs on a premium basis. Of course it would be difficult to measure my efforts, for example, in devising records, studying equipment, consulting about what to buy—but that would show up in the general plant efficiency, wouldn't it?"

"Dream on, young man, dream on," said George. "And I mean it—you're quite likely to get some place with such a plan in an outfit like yours. But here come the ladies . . . "

* * *

Possibly the two men should have spent the time talking general business conditions—wondering when things will get back to normal. But, after all, where would doing so have gotten them? As it is, they may have an idea that, if put into practice, will increase the net profit of Frank's firm. What say?

Is it feasible to pay a bonus on maintenance work?

Can individual repair jobs be performed successfully on a premium basis?

What method of measuring the work of the maintenance department would you suggest?

(Answers to previous questions start on the following page)

READERS' ANSWERS

to previous questions

Shall There Be a National Association of Maintenance Engineers?

(Question presented in the November issue)

THERE should be a National Association of Maintenance Engineers that would bring together the men who have to fight that three-headed animal, Electrical, Mechanical and Building Maintenance.

The dues? We would pay them ourselves gladly. And the traveling expenses to the meetings? Well, we would see that we get there.

H. G. SCHROEDER, *Maintenance Engineer*
S. B. Thomas, Inc.
Long Island City, N. Y.

NO maintenance engineer, unless he had a large private income, would care to bear the expense of a convention, especially where his employer would be the one most benefited, and I am sory to say that there are only a very few companies that realize the value of such conventions, and will gladly send their representatives. I belong to three international and national societies, and I have never had the opportunity of attending a convention with expenses paid by the company, although there is one meeting a year for the special benefit of the industry I represent.

The formation of an Association of Maintenance Engineers is desirable. I do not know of any organization that might form a nucleus for such an association. Maintenance ordinarily falls under the category of either electrical or mechanical, serving which there are two main bodies—the A.I.E.E. and the A.S.M.E.

What might be feasible is the formation of sections for each district. Delegates from the various sections could be sent at the expense of the sections to national conventions. Membership should be confined as much as possible to plant, power, mechanical and electrical superintendents, and master mechanics. In some plants one member only would be eligible, while in others as many as five, or even more, might be eligible.

H. E. STAFFORD, *Electrical Engineer*
Port Arthur, Ont.

THERE is no disputing that an organization which links into closer association a body of men, each intensely interested in similar problems; each nursing ideas, both tried and untried; all enthusiastically anxious to discuss and exchange these ideas, means real co-operation, beneficial to all concerned, including both employee and employer.

The maintenance engineer is among the few today who try to stand alone. He evidently has been too absorbed in fitting himself to the needs of his own work to realize that so many others have done, and are doing likewise; or to appreciate the enormity of future possibilities in this specialty. I feel that my experience in this field justifies the unhestitating statement that maintenance men as a whole are inclined to be absorbed in furthering their knowledge in their work rather than in the popular art of depriving personal profit from their efforts; and the nature of their duties so encourages this tendency that they are prone to neglect or underestimate other angles of the importance of their services to others.

Organization would not only open opportunities for recognition but would create advantages for the employer that he would have at his command the ideas and assistance of the entire organization through the agency of the one he employs.

As maintenance men are as a rule studious minded and modern it appears to be the most practical means of making a start, but would hinder the independence of policies, lessen the interest of prospective members, and create many unforeseen obstacles. In the same way I believe that the problem of eligibility for membership is unusual, serious, and difficult.

W. O. HURLBUT
Otis Elevator Company
San Francisco, Calif.

Who Shall Specify Equipment?

(Question presented in the October issue)

THE purchasing of plant equipment represents a specialized technical phase of purchasing, differing considerably from that of raw and stock materials, where inventories and market study are essential prerequisites.

The purchasing agent for the most part is a student of commodity trends and capable of carrying out an extensive market study. Rarely, however, does he possess an intimate and intelligent knowledge of shop conditions.

The departmental head is a specialist in his particular field, and entitled to every consideration in the specifying of equipment. When insisting on a certain line of equipment he has undoubtedly weighed and taken into consideration past performance, maintenance, and possible standardization of units, as well as initial price.

The purchasing agent, however, should be more than a passive "order taker" and follower up. He should be continually searching and scrutinizing sales literature and amassing a wealth of technical information in an effort to obtain cheaper substitutes, which will

give equal cost performances. He should be constantly requesting samples and ordering trial units of smaller maintenance equipment items and insisting that shops give careful attention to such trials and advise him of the results.

Performance costs and other things being equal, the purchasing agent should be given the authority for placing the order. Here reciprocity, purchasing concessions, and such technicalities, in which the departmental head has only an indirect interest, may be involved and adhered to.

H. S. DEELEY, *Planning Engineer*
Canadian Johns-Manville Company
Asbestos, Quebec.

THE specifying of equipment should come from the plant engineering or maintenance departments. The man or men responsible for the specifications have acquired, through publications and other sources, knowledge of what equipment is being made. They have the necessary engineering knowledge to determine just which type is theoretically the best. They know from practical experience, if an entirely new type of equipment is not specified, just what the maintenance factors are. This is a very important item.

The purchasing agent sees the situation mostly from the standpoint of price. It is his job to buy materials which will come within the specifications given out by the engineers for the cheapest price and secure delivery within specified time. The purchasing agent should never change the specifications without the O.K. of the person making them.

In many cases the engineers should get prices from the purchasing agent and consider them with the operating and maintenance factors of the different types of equipment is not specified, just what the maintenance returns for the money.

NELSON C. BARTLETT
Maintenance Department, Roofing Mill,
Bird & Son, Inc., East Walpole, Mass.

SPECIFICATIONS for goods to be purchased should be made by an expert in that line. The purchasing agent should be relied upon for his commercial knowledge and the person using the goods for specifications of the physical and other necessary characteristics.

As a general rule it is not a function of the purchasing agent to initiate specifications as to the quality of the materials. He should be supplied with the specifications in detail and be required to purchase goods only of the specified quality. (Note that specified quality is not to be considered synonymous with purchasing goods of the trade name specified.)

This particular case calls for closer contact between the works manager and the purchasing agent, and Frank. It may be that the purchasing agent has had comparative tests made by reputable laboratories on the relative efficiency of Smith & Robinson bearings. Does the purchasing agent know that Frank has not made such tests? What kind of a works manager would substitute equipment specified without consulting the purchasing agent? Why should the purchasing agent proceed likewise without asking Frank why he picked these bearings?

What this case, and all similar cases call for, is co-operation and investigation. The slogan "Before you invest—Investigate" might very well be applied to all equipment purchases. With complete investigation there will be very little reason for discord between the Frank's and the purchasing agents.

WILLIAM A. WALTER, *Purchasing Agent*
Pneumatic Scale Corporation, Ltd.
North Quincy, Mass.

THIS question never will be settled to the satisfaction of everyone. The foreman of the maintenance department is primarily interested in getting equipment and parts that will give the best service and perform their functions with the minimum of adjustment and repair. Naturally price difference, even to 100 per cent between two roller bearings, for example, one of which has proved itself to be the best for some particular place, does not loom very large in his sight. He knows that often the failure of a $5 or $6 bearing will cause labor expense of $15 or $20, not to mention the loss caused by shutdown.

On the other side of the fence is the purchasing agent, whose job is to look out for the cost of the stock and equipment that it is necessary to purchase. Unless he has had experience in the maintenance department he will naturally look to the price rather than to the fitness of some particular make of bearing.

In my estimation the co-operation of the two, where the question of quality versus price arises, is the only fair way to deal with the subject.

GEO. R. MILLER, *Head Millwright*
Pacific Lumber Company
Scotia, Calif.

What Maintenance Policy During Depression?

(Question Presented in the September Issue)

VOLUME of business has more to do with the maintenance policy than the recommendations of those responsible for plant upkeep. My experience parallels that of others in past periods of prosperity. There seemed to be no limit to the amount of money available for plant betterment as long as production operations were at a maximum.

Much repair work was done over Sundays, or holidays, and in overtime periods when its cost was considerably more than it would have been if performed in the course of the regular working periods. Defective equipment was kept in service longer than it should have been; consequently it was a greater task and a more expensive one than if the repair work had been done at the time the defective condition was first observed.

Such cases cause one to wonder whether a saving would result if these unnecessary expenditures were eliminated, or if a portion could be carried over into the depression period and expended for plant maintenance and repair.

In prosperous times management tends to ignore non-productive expense and in the face of a depression

HARRY W. BENTON

Plant Engineer, Pratt and Whitney Company, Hartford, Conn., advocates the use of a budget system to keep maintenance in check at all times.

the first place reductions are made is in the non-productive department. The policy cannot be established by the plant engineer; however, in my opinion, if plant maintenance is handled properly during prosperous times little difficulty will be experienced during depressions. By the use of a budget system maintenance can be kept in check in proportion to production expenses.

HARRY W. BENTON, *Plant Engineer*
Pratt and Whitney Company
Hartford, Conn.

IT has been my observation that almost all of us tend to magnify both ends of any business cycle. When business is good we are inclined to let little leaks, little wastes, and little extravagances go unchecked. Then when a depression sets in and the salesmen come back with unfilled order books, management is inclined to curtail activities that are letting so much of the profits slide over to the red side of the ledger. What is to be done?

I think that the business men of the United States are coming to realize the necessity of keeping all equipment well maintained all the time. Business men, representing industrial leadership, must realize that some of the blame for the depression (an automatic reaction from a surplus of goods) should be laid at the doors of that overly worshipped giant, "Production."

Maintenance, to do its full duty around a plant must be continuous, but even more than a task it must, and will, become a definitely planned program.

I have had some interest in following the vicissitudes of the soft-coal mining industry. Coal mining has always been a seasonal industry with an average shutdown of seven months a year; the same old annual cycle of thundering volumes of tonnage in the winter at fabulous prices (when the coal-operators were not staging a price-cutting war) and the accepted slump the following spring. In winter the equipment is used and abused to the limit and in summer the management neglects it. "We won't need it until fall, so why fix it now?"

From solely the maintenance man's viewpoint equipment should always be taken care of. All too often equipment which would have taken only a few minutes to repair properly yesterday will fail totally tomorrow.

From another viewpoint management must continually stimulate work in the research laboratory to develop new uses for its product and overcome objections and shortcomings of products in the known applications. I believe that in some respects, at least, the bituminous mining industry realizes the trend.

This latter viewpoint takes in the tremendous expanse of one of the basic industries. Therefore, is it foolish for the maintenance engineer to look beyond his own domain and, as he sees men without jobs, machines without men, the mine without an order on its books, ask himself, "Why must we have hard times?"

CARL A. WAGNER, *Electrician, Denver, Colo.*

IMPROVEMENTS and general upkeep depend largely upon company policies and methods of accounting, regardless of whether business is enjoying its normal production. Many small industrial plants do not have the exacting accounting system of the larger plants and a great many improvements are classified under an operating charge that in reality should be a capital account.

Retrenchment and delaying the making of repairs owing to depressed times are costly factors. All apparatus, regardless of its nature, needs looking after every so often and if this is delayed it oftentimes means a replacement at an additional cost where a repair should have been made.

Few maintenance engineers realize that nearly every piece of equipment will deteriorate faster standing idle, if not properly laid up, than in operation. That is another argument that depression maintenance is necessary. For instance, laying up a steam-driven pump means pulling all packing (which is wasted), greasing all rods and other movable parts, draining the cylinders and greasing after removing the cylinder heads. When starting up all of this work must be redone, which adds to the cost of non-production, or depression, as the case may be. It should be considered necessary work to save equipment.

General maintenance of plant equipment should not be combined with new and different installations for improvements, however, replacements with the same kind of apparatus is strictly a maintenance job. Any delay replacement, even in depressed times, is oftentimes the most expensive method of maintenance, and one that should not be overlooked.

J. H. WICKMAN, *Consulting Engineer*
Long Beach, Calif.

Do Centralized or Decentralized Stores Better Serve Maintenance?

(Question Presented in the August Issue)

GEORGE and Frank have hit upon a very important topic. After many years of experience, I feel that all stores should be centralized under one head because of the trend towards the centralization of materials, and the keeping of inventory to a minimum. This department, however, should be under the jurisdiction of a man mechanically inclined, and who is conscientious in keeping the stock at a safe minimum consistent with the operation of the plant. Its supervision should not be trusted to boys, or employees who are irresponsible.

It is the duty of the plant engineer in charge of the maintenance department to draw up a schedule of max-

imum and minimum requirements on each article. He should also specify the articles to be stocked. Co-operation between the stores and maintenance departments must be cordial, and whenever the plant is shut down for holidays or other occasions, the engineering department should have access to store equipment. The plant engineer's department must inspect the storeroom and check its requirements at frequent intervals as a means of adjusting the stock to changes in operating conditions.

Whenever a large repair job is anticipated the stock department should be given ample time to cover requisitions so that the job may be completed without delay. In this connection take the case of fire brick. The requirements will depend upon the size of the plant, but under all circumstances enough of this material should be kept on hand to re-set one boiler.

Stock supplies are of paramount importance, not only to the power-house personnel, but to the members of other trades employed in the organization.

I believe that the central storeroom should be supplemented by individual stores in each department, containing a minimum supply of articles which are in constant use. For instance, auxiliary supplies of packing, valve disks, oil, grease, compound, waste, and those articles for power-house use, which can be classified as expense materials. Major articles for extensive repairs, such as valves, fittings, fire brick, pipe covering, and pipe should be handled by the central store.

If the plant engineer will carry out his job in specifying and checking supplies, and if the stock department will co-operate with the plant-engineering department in keeping these supplies on hand, good results will be obtained.

K. D. HAMILTON, *Mechanical Department*
Geo. E. Keith Company
Campello, Brockton, Mass.

How Big Is Maintenance?

(Question Presented in the May Issue)

THE final aim of any concern is cooperation in all departments. Because the maintenance engineer is not confined to any one department his advice is of value in any plant meeting.

I do not believe in the maintenance engineer's being the purchasing agent or designing engineer, but he is the man to give the purchasing agent the specification and put the designing engineer's ideas into practical use. He is not the builder of new plants but does tell the architect what to put into the building to assure undisturbed flow of production without accident hazards.

A case I witnessed may indicate the important position that the maintenance engineer should have. A product was costing too much. The management called in an efficiency engineer. After a thorough survey a bonus system was installed. The result was an increase in production, but only on account of manpower. If modern equipment had accompanied the bonus system the output would have been much bigger. It seemed to me that in this particular case the maintenance engineer was the fellow to cooperate with, for he knew all the weak spots of layout and equipment.

Often special machinery is designed by the engineering department. Before building this machinery the maintenance engineer should approve the design from the point of view of repairs and easy interchanging of parts. In case of breakdown it would not be necessary to tear down the whole machine. I guess we all know of those long night and Sunday hours put in, in order to repair breakdowns.

C. SCHAFER, *Research Department*
Libbey-Owens-Ford Glass Company
Toledo, Ohio

MAINTENANCE properly covers all work involved in keeping in working condition the production machinery, power transmission equipment, and yards and buildings. It has the responsibility for fire prevention; policing of company property; lighting; cleaning; sanitation. There also may be added safety and accident prevention.

In large plants maintenance generally is under the supervision of the master mechanic or plant engineer. In others it is broken up among foremen who are responsible to the plant engineer or superintendent.

In the last analysis there is not much in the title of the position but a great deal in the carrying on of the work.

WM. C. BETZ, *Master Mechanic*
Fafnir Bearing Company
New Britain, Conn.

MAINTENANCE properly means care of equipment to prevent the stopping of production and the delaying of the shipment of the finished product. I shall confine my comment to outlining the maintenance activities in a small plant generating and purchasing 12 million kw-hr. annually.

In the boiler house are three oil-burning boilers, desuperheater and reducing valve, 3,750 kva. turbo-generator, superheater, and the necessary pumps, fans, and other auxiliary apparatus. To keep this part of the plant operating continuously and efficiently the water treatment must be taken care of, boilers must be washed and blown down, pumps packed, valve seats and packing must be kept tight, oil-burners kept clean, and there are many other small duties.

In the turbine-room are located the turbo-generator, air-compressors, condensers, condenser pumps and numerous pieces of equipment which must be periodically inspected and adjusted. The pipe-shop crew must pack valves, tighten unions, replace badly worn pipes, and maintain the thousands of feet of pipe necessary to transmit these power providers to the various parts of the plants.

In the electrical distribution department are located the motor-generator sets and rotary converters along with the 2,300-volt, 550-volt, and 250-volt distribution boards with their oil and air circuit breakers and the electrically operated mechanism for these breakers, overload and reverse current relays, recording and integrating watt-hour meters, voltage regulators, and the usual other equipment.

Out in the plant in the manufacturing division are electric hoists and traveling cranes with their motors, control equipment, and mechanical parts to be inspected, adjusted and lubricated; a.c. and d.c. motors from fractional to 1,500 hp. to be kept clean, and their corresponding brushes, commutators, slip-rings, bearings and the manual and remote control apparatus to be looked after. The control apparatus must have contacts

FREDERICK W. CARTER

In charge of Power and Maintenance, Waterbury Clock Company, Waterbury, Conn. A constant contributor whose discussions add considerable interest to the Forum.

changed, springs adjusted, dash-pots filled, and insulating oil changed. There is the automatic telephone system of 95 telephones with all its intricate parts to be kept clean and properly adjusted, and storage batteries to be maintained. The electric truck batteries require distilled water and recharging, and the mechanical parts of the trucks need attention.

There are the potentiometer system instruments of heat-recording and controlling of the annealing furnaces, various signal systems, miles of power and lighting wiring and conduit, lamps and reflectors to be kept clean, outside transmission lines to be patrolled and many other pieces of equipment to be watched constantly. The different types of manufacturing machinery require lubrication and adjustment and there are belts and chain drives to be kept tight, reduction gear units to be inspected, and much other special machinery that require special attention.

All the work written of here, and some other work not referred to, is classified under maintenance in this particular plant and gives only one illustration of the great amount of ground covered.

W. D. Bristow, *Mechanical Engineer*
Washburn Wire Company
Phillipsdale, R. I.

THE primary purpose of maintenance should be to anticipate and prevent interruptions in operation and loss of output due to bad-order or broken-down machinery and equipment. The secondary purpose should be to correct conditions that have caused failure.

As a part of operating procedure the work of maintenance should classify as follows: Make emergency repairs; inspect machinery and equipment at such intervals as will insure detection of misadjustment, wear, or impending breakdown; make such repairs or replacements as inspection shows to be necessary; keep systematic records of equipment, inspection, and repairs; keep tickler records to warn of necessity for reinspections; suggest and assist in developing changes and improvements in design of machinery and equipment to decrease liability of breakdown and necessity for frequent adjustments or repairs; put into effect changes and improvements developed under the foregoing; and operate such service departments as may be assigned to the maintenance department.

Limitation of the functions and work of the maintenance department are a part of company policy and should be decided by the president. As an illustration: Some concerns turn over to their maintenance departments the design and installation of power plant equipment. Others turn this work over to outside engineers to design and supervise construction and installation. In most cases the latter method is more economical.

Nevertheless, the maintenance department should have the biggest, if not the last, word on the purchase of all electrical equipment, mechanical power transmission apparatus, lighting, and other equipment that the department knows of by experience.

George H. Gunn
Maintenance Section, Engineering Department
Naval Aircraft Factory
Upper Darby, Pa.

Should Maintenance or Production Department Control Cranes, Elevators, and Trucks?

(Question Presented in the April Issue)

IN numerous small plants it is found most efficient to have both operation and maintenance of plant transportation equipment directly in charge of one who is also responsible for production.

In larger establishments consideration must be given to planning, scheduling, and inter-departmental transportation and all must dovetail into the finished picture of lowest costs. This may mean setting up a separate plant transportation department responsible for all transportation, or its responsibilities may include only inter-departmental and local outside transportation. Where production departments are numerous and varied, the moving of products within the department by electric jitneys, hand trucks, small cranes, and the like, should come most frequently under the supervision of the various production heads who are closest to the scheduling needs. Freight elevator operators well may come under supervision of the maintenance of equipment or building departments because their work is largely routine.

In spite of the fact that many large industries place all transportation under the head of maintenance it is my belief that one of the other methods is more effective; it is a problem within itself. Special moving problems, involving rigging and special consideration, belong to the maintenance department.

The maintenance department should have a voice in the selection of, and in certain instances authority in specifying moving equipment to be used—as records and experience dictate. Regular inspections, repairs, and stock parts should by all means be covered by this department. Thus, electric jitneys and batteries, ignition systems, electric cranes, etc., would be maintained by the electrical department; freight elevators by the millwright department; trucks under the repair department; and so on, depending upon the particular method under which the plant maintenance work is handled.

H. L. Schultz
Assistant Superintendent of Maintenance
The Carborundum Company
Niagara Falls, N. Y.

AROUND the WORKS

A section devoted to short articles describing practical methods devised to meet specific operating conditions. The items may refer to details of installation, inspection and testing for maintenance, wiring, repair, and replacement.

Mill Drive Capacity Boosted During a Quick Change-Over

A CHANGE-OVER was recently made in the blooming mill and job mill drives at the Ashland, Ky., plant of the American Rolling Mill Company. To permit sufficient time to do the work planned these mills were to be shut down on the 30th of one month, with the understanding that the apparatus had to be ready for operation at 7 a.m. on the 9th of the following month.

In the blooming mill there was a flywheel set which consisted of a 1,500-hp. induction motor, a 2,400-kw. generator, a 55-ton flywheel, and a 75-kw. exciter. The plant had one spare armature for the 2,400-kw. generator. In addition, there was a 2,500-hp., d.c. motor driving the rolls. Our shop was called upon to make the change specified with the existing equipment.

It was planned to provide a new base for the flywheel set and a new field for the spare 2,400-kw., d.c. armature, thus making available for use another generator; to re-wind and separately ventilate the 1,500-hp. motor for 2,700-hp., rating; and to place all the flywheel equipment on the new base, thus having one 2,700-hp. induction motor, two 2,400-kw. generators, one 55-ton flywheel, and one 75-kw. exciter on the new base. It was also planned to reconnect the 2,500-hp., d.c. motors on the main rolls for 3,250-hp. rating.

The equipment was shut down at 6:30 p.m. on the 30th and the disassembly of the set was started immediately. The work of stripping out the windings of the 1,500-hp. induction motor was begun at 7:30 that same night. The new winding was finished at 3:30 p.m. on the 4th of the following month—less than five days from the time the plant was shut down. In the meantime, the bearing pedestals were aligned on the new base, holes were drilled and tapped, dowel pins placed in position, and a new series field winding installed on the old d.c. generator.

All necessary changes were made in the 2,500-hp. unit, making it a 3,250-hp. motor and, in accordance with the latest practice, all the control panels for the apparatus were re-wired for the rated loads.

In the job mill there was an 1,800-hp. Scherbius-connected induction motor operating at 20/300/360 r.p.m. The rotor and stator of this motor were rewound while the core of the stator was being restacked, making it a 4,000-hp., 360-r.p.m., constant-speed motor. All of the control equipment was re-wired accordingly. This motor was shut down in the forenoon of the 30th so that the work of stripping out the stator windings could begin at 2:30 that afternoon. The work was finished at 9 a.m. on the 7th, and the same operation on the rotor, begun half an hour after work started on the stator, was completed at 9 a.m. on the 8th. The control equipment for this motor was ready for operation at 4 a.m. on the 9th.

All the equipment was ready for operation at noon on the 8th but the afternoon of that day was taken up in making tests to prove the thoroughness of the work. The mill began rolling steel at 7 a.m. on the 9th.

EMILE FRISARD.
Superintendent
General Electric Service Shop
Cincinnati, Ohio

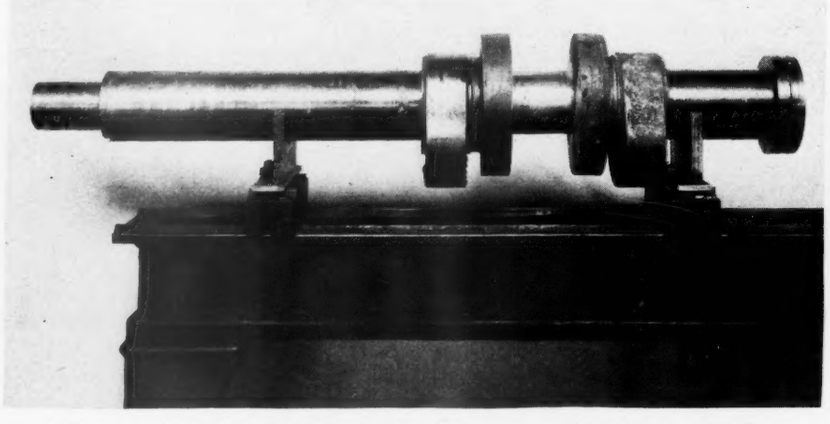
Arc Welding Saves $500 in Repair of Crankshaft

AN excellent example of the possibilities of the arc welding process both in the repair of a broken piece and building up a worn part is presented by the crankshaft shown in the accompanying photograph. This crankshaft is used in our plant on a double-acting punching and drawing press, which weighs approximately 18,000 lb. and exerts a pressure of 100 tons on the ram.

The shaft is 6½ in. in diameter, and 70 in. long. The crankpin is 6 in. in diameter. The crack, which occurred in the crankpin slightly to the right of the center, was repaired by the arc welding process and the shaft returned to service at a saving of $500, approximately.

In making this repair the shaft was mounted on a lathe bed and a clamp was placed opposite the crankpin to prevent warping. The crankpin was cut away at the point of fracture to a depth nearly equal to the full diameter of the pin, and to a width of more than an inch. This crevice was filled in by means of the metallic arc welding process.

Before turning down the crankshaft after the metal had been deposited by the arc, the long end of the shaft was lined up to run true in the lathe. When this was done it was found that the short end was slightly distorted. To compensate for this distortion a layer of weld metal was put on the short end. The excess was then turned down to secure perfect alignment of the shaft from end to end, and to permit truing.



A deep crack in the crankpin of this shaft was repaired by arc welding, at a saving of about $500, in eight hours.

It took two men about eight hours to complete the repair of this crankshaft by use of arc welding. This time is considerably less than would have been required to make a new shaft, and the cost was also much lower; yet the repaired shaft will perform the work required just as efficiently and probably last as long as a new one.

FRANK MOSSBERG.

President and General Manager, Mossberg Pressed Steel Corporation, Attleboro, Mass.

Safety Bar to Prevent Belt Pulley from Running Off Pulley

IN connection with the item under the above heading by T. C. Witherspoon, page 148 of the March issue of INDUSTRIAL ENGINEERING, I would like to utter one or two words of caution. The use of the iron rod which is advocated is all right provided it is not employed for the sole purpose of keeping belts on pulleys, which are continually running off owing to misalignment.

Makeshift devices such as pieces of wood nailed in place, which press against the edges of the belts are legion. The belts would surely run off if these supporting members were not there. In other words, alignment is poor and the belts have a natural tendency to run off.

When a leather or any other type of belt continually rubs against a board, iron rod, or even finger shifters, the edges of the belt soon begin to fray and it wears out prematurely.

Belts run off of pulleys for various reasons. Sometimes leather stretches more on one edge than on the other, causing the belt to become crooked and run off. Sometimes a low coefficient of friction causes the belt to slip excessively and run off. Sometimes the belt is very stiff; its surface adaptability is low.

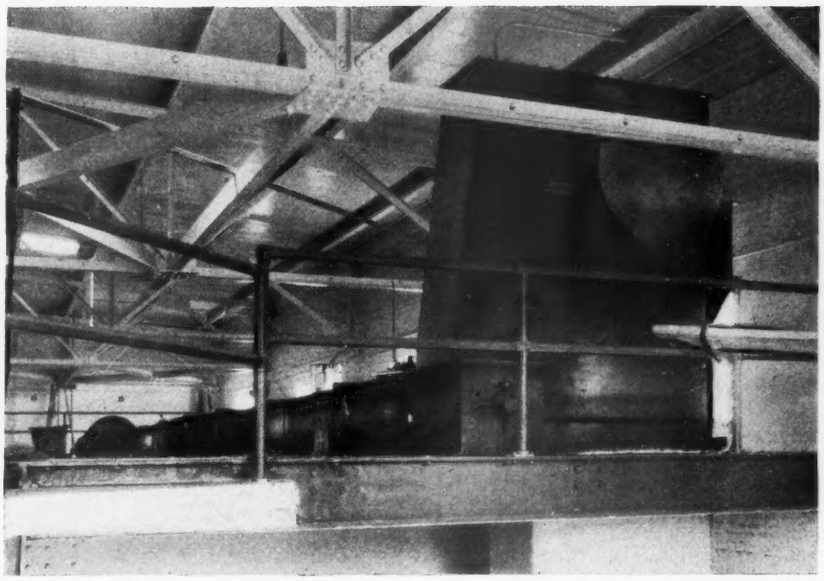
A metal rod, as advocated, should not be used to overcome the deficiencies enumerated. The rod cannot and will not overcome them. The logical thing to do is to properly install the belt in the first place for belt will not run off the pulley when other conditions are right.

W. F. SCHAPHORST.

Newark, N. J.

Paint Emphasizes the Modern Trend in Stoker Rooms

TO those engineers who remember when black paint was the standard, the accompanying photograph of the top of a modern coal bunker is shown as proof that the present styles in painting are a vast improvement on the old.



What dust-proof apparatus and light-colored paint can do for a stoker room.

This entire boiler room is aluminum painted, which is contrary to what one might expect for a stoker-fired job. All the coal conveying and elevating equipment is dustproof. When you find a modern plant in which light-colored paint makes the formerly dim and dusty corners bright and usable you will never use dark-colored paint again.

In a plant of this kind you can take visitors up on the bunkers without having them first don overalls. And you would be surprised at the difference it has made in the morale of the operating crew. No more throwing of dirt and trash into dark corners to serve as a fire hazard. The crew takes an interest in keeping it clean.

Next time you have an opportunity to do a little painting try some light-colored paint, particularly if the room happens to be dark and dismal. Aluminum paint is good, but there are several washable paints that are quite satisfactory for a considerable range of temperature, and which may be used to advantage in working out an attractive color scheme.

P. F. ROGERS.

454 Seventh Street, Brooklyn, N. Y.

Tailor-Made Switchboards Permit Switch Group Assemblies

OCCASIONALLY a job comes up where a number of pieces of electrical equipment such as magnetic switches for motor starting, safety switches and fuse blocks must be mounted in a group. This type of apparatus is usually of low voltage, 220 or 440. To construct a marble or slate switchboard for this purpose would be costly and unnecessary, whereas a wood-constructed board would increase the fire hazard. To spread the equipment out promiscuously merely tends to clutter up the room, so the obvious answer is a switchboard large enough to hold the equipment, which would be low in first cost, and fireproof.

I have tried many different types. Wood covered with asbestos serves very well, however, there is still a better material from the standpoint of wear. This material is known by several trade names, but by analysis it consists essentially of asbestos fiber mixed in Portland cement.

It may be obtained in thickness ranging from $\frac{3}{16}$ to $\frac{3}{8}$ in. and in sheets 48x96 in. It is strong structurally and very durable, and can be worked insofar as the cutting and boring of holes are concerned.

In the construction of a switchboard the support is made up from angle iron in the usual manner, being careful, however, to space the angles so that the exceptionally heavy switches and other pieces of equipment can be bolted through the material to the cross supports. It is to be pointed out that this material is not an insulator in the strict sense of the word and, therefore, all electrical elements mounted upon it should have their own insulated bases with which they are equipped. The board is intended to receive the units of electrical equipment as a whole to form a neat and orderly assembly.

It may be painted machine-tool grey to blend with the balance of the equipment or it may be painted black to match the electrical equipment.

Waterloo, Iowa. H. C. CHARLES.

Noise in Fan Motor Traced to Unexpected Source

RECENTLY one of our shop ventilating fans developed a serious thumping noise. On examination no defect could be found in either the fan or its driving motor and the cause of the noise remained a mystery for some time.

Eventually the noise was traced to the conduit which carries the motor feeders. This conduit was run from a panelboard down the wall to the motor. A large press was located on the other side of the wall and the conduit for its motor was led to the same panelboard.

As the motor and press were on one bedplate, with which the conduit was in contact, the thumping of the press was thus transmitted to the panelboard through the conduit, and from the panelboard to the fan motor through its conduit. When this conduit was changed over to another panelboard the thumping ceased. W. E. WARNER.

Billericay, England.

Painting Cold Surfaces in Warm Rooms

ANY plant engineer or factory maintenance man who has attempted to paint the exterior surface of metal tanks containing cold water, when such tanks are located in warm rooms, has found it almost impossible to make the paint adhere. Unless these tanks are well insulated the exterior surface will be so much cooler than the surrounding atmosphere that moisture will condense and form a film that will prevent the adhesion of any ordinary type of paint.

It has long been the practice to drain cold water, water softener and brine tanks, dry them with induced heat and then paint them. This method meant either loss of time and considerable labor, or the tanks were left in an unpainted condition to soon become unsightly and badly rusted.

Using a proper mixture of a high-grade emulsified asphalt, Portland cement, and clean water makes it possible to protect surfaces of this nature with no shut down of necessary equipment or special precautions taken other than to clean the metal of all rust and old paint. As water is a necessary ingredient of this type of protective coating it naturally follows that a film of moisture, such as one would encounter under these conditions, will not interfere with the proper application of this material.

Directions to be observed are as follows: Clean the metal surface of all rust and old paint and then wash it thoroughly with clean water. While the metal surface is still damp brush over it a thin coat of emulsified asphalt that has been diluted with 25 per cent of cold water. See that the water is thoroughly mixed with the asphalt and that this coat is not brushed too much. Allow this coat to dry for about one hour or until it becomes dry enough that it will not stain the fingers.

For the next operation sift a gallon measure of Portland cement into a gallon of clean water. Stir thoroughly to make certain there are no lumps. This cement mixture should then be added to six gallons of emulsified asphalt, thoroughly stirred and then poured through a fine screen to remove any lumps of cement that may have gathered. This mixture should then be brushed over the first coat at the rate of two gallons to each hundred square feet of area. This surface should be protected from abrasion for 48 hrs., after which it may be painted with dark-colored asphalt paints or aluminum paint if the black asphalt color is objectionable. The oils contained in these paints will strike into the asphalt and prevent any peeling of the coat unless the condensation of the asphalt surface is very heavy. In that case it will be necessary to leave the asphalt unpainted.

STANLEY C. HUNTER.
Maintenance Counselor
The Tremco Manufacturing Company
Cleveland, Ohio.

Cooled Drinking Water Makes for Good Welfare

CENTRAL drinking-water cooling systems for employees in industrial plants are becoming almost indispensable. The accompanying illustration shows an installation which is automatic in its operation, in one of the Geo. E. Keith Company factories. This unit serves 13 bubblers located throughout the building, which replaced the old-fashioned ice boxes formerly used during the summer months.

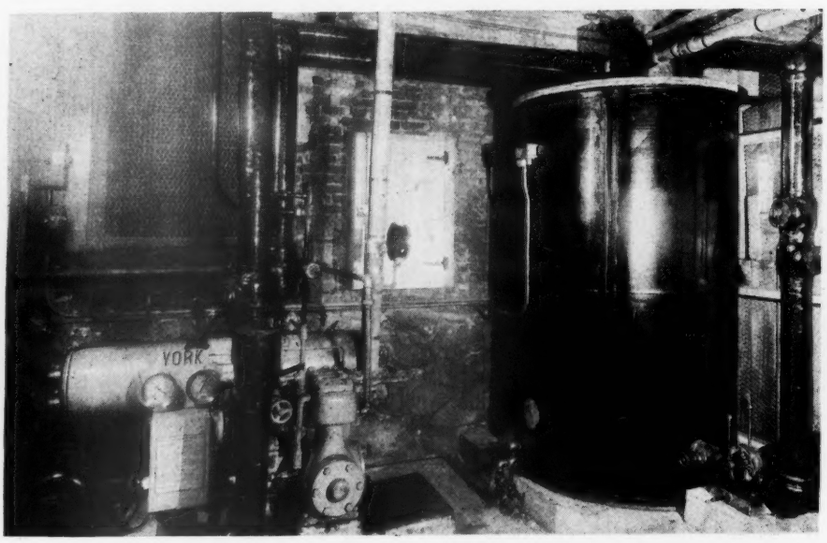
It was our experience that the former system was expensive and that the results were unsatisfactory in that the water was cooled as long as the ice lasted. During the hot days when a large number of employees were drawing on the system, the temperature of water became higher in the afternoon, so as a result we decided to install a complete automatic water cooling equipment to furnish a constant supply at the correct temperature 24 hr. a day.

This system comprises a half-ton machine which supplies the storage tanks with cooled water, and from which a small pump, shown at the lower right of the illustration, circulates it throughout a return pipe system to the different bubblers.

A thermostat on the cooling tank is set to maintain water temperature at 42 deg. F. We find that there is a loss of but one degree in circulating the water through the entire pipe line of 500 ft. in extent. An efficient pipe covering reduced the transmission losses to a minimum.

A thermostat on the storage tank automatically starts and stops the ammonia compressor to provide constant water temperature. There is very little maintenance on this equipment, as it is only necessary to keep the motor oiled and the ammonia compressor crank case filled with oil to insure positive lubrication. Twice each year the condenser coils are cleaned to maintain the efficiency of the machine. Employees in the factory appreciate the difference between drinking water cooled by ice and that which is furnished at constant temperature by the machine.

K. D. HAMILTON.
Mechanical Department
Geo. E. Keith Company
Campello, Brockton, Mass.



All this equipment for plant welfare. It supplies thirteen bubblers distributed along 500 ft. of pipe line with drinking water at a constant temperature.

Coil Support Insulation for Rotor Banding

By A. C. ROE
Renewal Parts Engineering Department Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

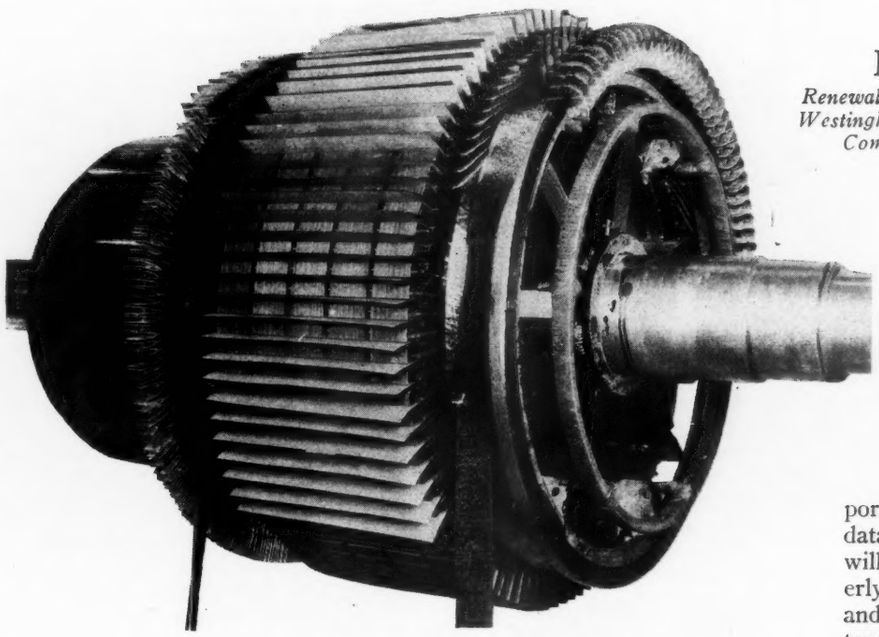


Fig. 1—Rear coil support and support for cross-connection.

GOOD banding jobs can be secured only when all details that affect the finished product have been given proper attention. One of the important details of any rotor winding is the methods and materials used to prepare and insulate the coil supports upon which the coil ends rest. In fact, the insulated coil supports are the foundation upon which the end-winding retaining bands are built.

A few types of coil supports and the materials and methods used to prepare them to receive the winding and retaining bands will be described in this article. Data of this nature should be of assistance in checking coil support insulation when stripping a rotor for rewinding, or when ordering new bulk or cut materials.

The function of a coil support is to provide a base upon which the coil ends can rest and be anchored to, when applying running or segmental bands of steel wire. These supports are attached to the armature by metal arms and form a conducting path to ground. Hence, the supports and attaching arms must be insulated to insure adequate protection from failures to ground.

When checking the insulation used on coil supports, check the outside diameter of the insulated support, or the height of the top surface of the support in comparison to the bottom of any slot. Also check the width, and overhang of the insulation, and how the supporting arms are insulated. These data insure that the finished winding will be of the proper diameter, properly insulated at points of contact, and have the proper creepage distances.

One type of ring coil support is shown in Fig. 1; concentric to the coil support is a ring upon which the cross-connecting winding is anchored. Note the distance the insulation extends below the surface of the coil support. In this case the arms of the coil support are not insulated as the creepage distance is ample. The arms of the cross-connection ring are taped.

Supporting rings used on the type of armature shown in Fig. 2 have the

Fig. 2—Front and rear coil supports with uninsulated supporting arms.

supporting or attaching arms designed to give ample clearance, permitting the omission of insulation from the arm. The top and sides of the coil support only are insulated.

Older types of armatures use cast-iron supports, with the arms close to the windings. This type of construction, shown in Fig. 3, necessitates insulating the arms to protect the winding. Fig. 3 shows the equalizer connections, in the form of a two-layer winding, back of the commutator. These connections rest on a metal coil support and when finished form a solid coil support for the armature winding.

Space does not permit covering all types of, nor methods of, insulating coil supports; therefore this description will be restricted to the more common types that illustrate good insulating practice.

Figs. 4 and 5 show how the coil supports of the types shown in Figs. 1 and 2 are insulated. The main insulation consists of a circle built up of two layers of treated, U-shaped insulation segments, with joints between the inner and outer layers, 2 or more inches apart. The channels are held in place with three layers of cotton tape, sewed and painted with a good, air-drying varnish. Fullerboard fillers are used under the U-shaped pieces to adjust the height of the end windings. When equalizer connections are fastened to the coil support, fishpaper washers or segments, as shown in Fig. 5, are applied to the side.

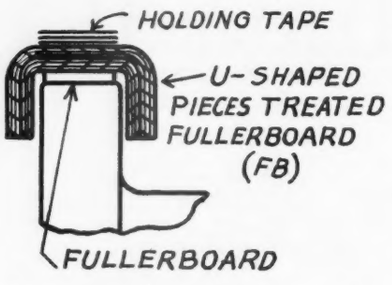


Fig. 4—Molded-paper, annular, channel-shaped rings.

Flat coil supports can be insulated as shown in Fig. 6, by applying at at least two layers of treated fullerboard and then shellacking coil support and each layer. If more than two layers are needed to obtain the required height, the first layer should be fastened to the coil support with screws, as shown in Fig. 3. Hold the layers in place with three layers of cotton tape sewed and painted with air-drying varnish. The fullerboard is cut into lengths and applied with butted or overlapping joints.

Some applications require that the coil support be completely covered with insulating material. One of this type, shown in Fig. 7, is covered with insulating tape as follows: Apply one layer of cotton tape half lapped and brush the air-drying varnish. Then apply two, three, or four half-lapped layers of a thick, treated-cloth tape, brushing each layer with a clear varnish. The number of layers to be used depend upon the voltage and operating conditions. Add one or two layers of treated fullerboard, as shown in Fig. 7; hold them in place with a layer of cotton tape and apply four coats of air-drying varnish.

In most cases it is necessary to use pads of sheet material consisting of two, three, or four strips of treated cloth, between two pieces of drilling, to insulate the section around the attaching arms. The taping should be carried out on the arms to obtain at least 1 in. creepage distance.

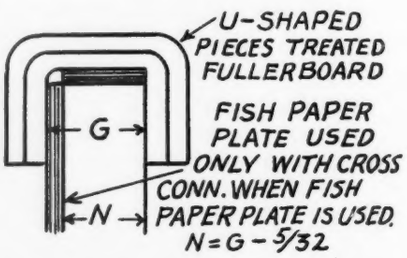


Fig. 5—These rings are the same as shown in Fig. 4, except for the side insulation for the cross-connections.

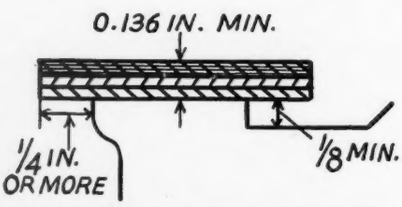


Fig. 6—Flat coil supports, indicating the minimum creepage distances.

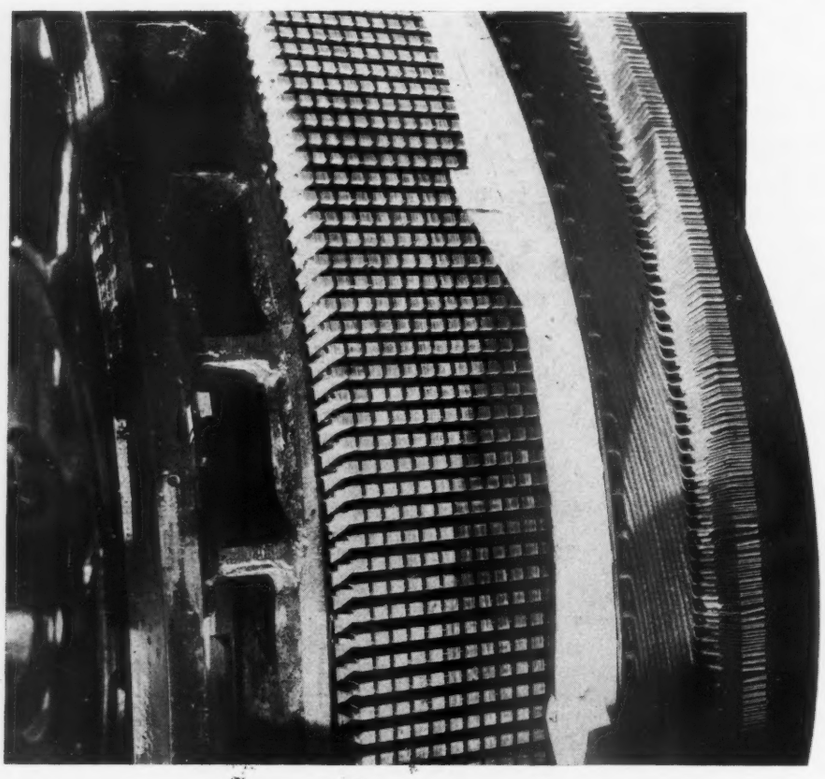


Fig. 3—Close-up view of a cast-iron rear coil support and arms. At the front of the armature the cross or equalizer connections form a coil support.

Sloping supports, as shown in Fig. 8, are insulated with sheet material, such as fishpaper and mica, etc., held in place with a drilling hood. First, paint the support with shellac. Hold one edge of the hood in place with strong twine; then apply the sheet material, pulling the hood over the last layer, and fasten in place with friction tape or twine.

The full-protection type of coil support shown in Fig. 9 requires tape

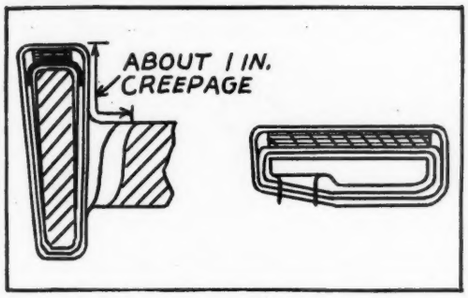


Fig. 7—How coil supports are completely covered with insulating tape before varnishing.

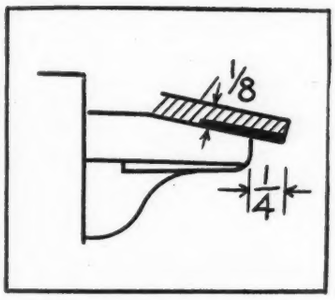


Fig. 8—Insulation applied to sloping-surface coil supports.

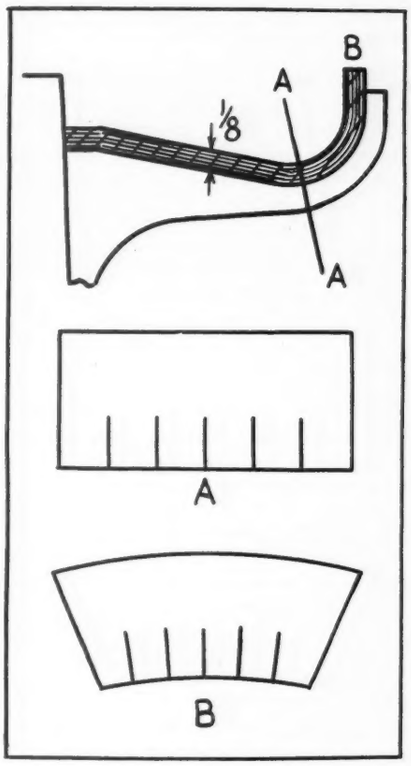


Fig. 9—Method of insulating full-protection coil supports.

and sheet material, such as mica and fishpaper, or treated-cloth "caps" cut to the shape shown in sections *A* and *B*, Fig. 9.

To insulate, shellac the support and apply one or two layers of treated-cloth tape. Then the section form *A-A* to *B* is insulated by placing the fluted caps in overlapping layers against the perpendicular end of the support. Apply three thicknesses of caps at a time, stagger or overlap the joints, build up to approximately ⅛-in. thickness, and then completely tape the remainder of the support.

Obviously, the preceding data indicate that each rewind job must be studied to determine the methods and materials that are to be used in preparing the coil supports if a well-finished job is to be expected.

When insulating coil supports, anchor all strips securely, apply all tapes tightly and use varnish or shellac to hold them in place or make a well-finished job.

It pays to cover exposed metal surfaces if there is any possibility of the winding being close enough to form a weak or doubtful spot.

Plans for National Industrial Congress Progressing Rapidly

PLANS for the technical sessions of the Second National Industrial Congress to be held in Cleveland April 13 to 18 are nearing completion.

As previously announced, the Congress will feature the three M's—management, maintenance, and materials handling. The maintenance program, under the direction of the editor of *Industrial Engineering,* is expected to present three sessions and tentative plans call for outstanding papers dealing with these subjects:

Organization for Maintenance
Budgeting for Maintenance
Maintenance on the Incentive Plan
Lighting Maintenance
Maintenance Painting
Tools for the Maintenance Departments
The Important Place of Electrical Maintenance
Electrical Maintenance by Schedule

Last year's venture into the maintenance field was an experiment. The attendance proved to be surprisingly large and the interest in the subject of maintenance as indicated by the warm discussion was intense. On account of the showing the maintenance sessions have been increased to three for the 1931 Congress. It is expected that advance copies of maintenance papers will be available so that they can be studied and discussions prepared in advance.

Industry recognizes the vital necessity for keeping plant and equipment in such condition that there can be no serious interruption to production. It realizes also that the function of maintenance can be carried out either economically or wastefully. It knows that maintenance engineers must be given their chance to keep themselves up-to-date, to carry on their education in regard to methods and equipment in order to insure economical maintenance. Large attendance and enthusiastic discussions may be expected.

Five or six sessions of the congress will be devoted to papers dealing with materials handling. About 60 per cent of this program has been completed.

Management subjects will be treated at several other sessions. The depression has brought to the front certain management problems on which it is expected much light will be thrown during the congress.

In conjunction with the congress the Second National Industrial Equipment Exposition will be staged. To show "What's new and how it can be profitably applied" is the objective of the exposition. Industry should profit greatly by attendance because of the increasing importance of modern equipment in answering the existing demands for more salable products at lower costs.

Safety Work Wins Electrical Award

R. W. E. MOORE, engineering manager of association activities of the Westinghouse Electric and Manufacturing Company was presented with the James H. McGraw Award, Manufacturer's Medal and Purse for 1930. The presentation was made at the annual meeting of the Manufacturer's Association at Old Point Comfort recently.

(Continued from page 19)

plies. The bevel pinion is always pushing away from its gear and against the motor, but if the thrust bearings in the motor will take care of this the application is not particularly bad. Both of these jobs are undesirable theoretically but both of them will probably run and give satisfaction.

As regards lengthening the life, this would need to be done by a change in material. Brass and fiber are probably used for noise elimination. If in the place of this a hardened material such as the "Tool Steel" hardening process were used on the pinion, its life would be 10 or 20 times as long as the life of the brass or fiber, and the cost would probably not be much, if any, greater. You would, however, have steel pinions running with the cast-iron gear and especially if the speed were high there would be the usual noise of steel gearing. If this noise is not objectionable this would be the logical step to take to solve the trouble.

E. S. SAWTELLE
Vice-president & General Manager
The Tool Steel Gear & Pinion Company
Cincinnati, Ohio.

Placing Primary and Secondary Circuits for Motor in One Conduit

A question has come up regarding the advisability of placing both the primary and secondary circuits for a 100-hp., 440-volt, 60-cycle, three-phase, wound-rotor induction motor in one conduit. I should like to know whether it is safe to do this and whether it is considered good or bad practice. Why?

McComas, W. Va. **E. R. L.**

WE have two extracting machines that are operated by 440-volt, 60-cycle, three-phase, wound-rotor induction motors; the primary and secondary circuits of each motor are installed in one conduit. These motors have been operating for some years without any signs of heating or trouble of any kind that could be ascribed to the method of wiring, and the installation has never been questioned by our insurance company's inspectors.

Ansonia, Conn. WM. T. ESTLICK.

I CAN cite a recent instance of a ruling by the electrical inspector on the question of placing rotor and stator leads in the same conduit.

Five overhead cranes were to be installed in a new plant that was completed last summer. The cranes were made up and shipped in sections with the motors and as much as possible of the conduit installed on the assembled sections.

The controllers and switchgear were also assembled at the factory and arranged for the primary and secondary circuits to be placed in the same conduit. After the first crane was wired the inspector condemned it and all of the cranes had to be rewired so that no rotor and stator leads were in the same conduit. This meant that an extra conduit had to be run to each motor and also to each of the three sets of traverse trolley wires.

The primary voltage was 550 volts and the rotor voltage, as I remember it, was 330 volts. The inspector's objection was that under certain conditions the difference of potential between the rotor and stator leads could be 880 volts, and inasmuch as the wiring was done with 600-volt cable he refused to pass the job unless 1,000-volt cable were used, or the conduits doubled up.

I might add that placing of rotor and stator leads in the same conduit is never allowed in Vancouver; the inspector was making a concession (in consideration of the fact that the cranes were shipped already wired) in offering to pass the work if 1,000-volt cable were used. However, all primary and secondary wires were placed in separate conduits, in preference to using 1,000-volt cable.

A. TOMLINSON.
Vancouver, B. C., Canada.

Voltage Will Not Build Up on Generator

A puzzling case of trouble has developed on a 35-kw., 115-volt, compound-wound, d.c. generator. The commutator bars became loose and the armature was sent out for repairs, although the generator ran satisfactorily except for considerable sparking during heavy loads and rapid wear of the brushes.

When the generator was reassembled after repairs had been made we checked all connections, but the voltage failed to build up. On the possibility that the fields had lost their magnetism, we charged them with a 6-volt battery, without result. By exciting from an outside source we are able to light only two 60-watt lamps. Will someone kindly tell me the probable cause of our trouble and how to locate it?

Huron, S. D. **B. H.**

IN the November issue Mr. Carl A. Wagner's answer to a question by B. H was very interesting. I have seen generators stand idle for a year or more, but have never known of one that had to be remagnetized. However, a good many fail to build up the voltage under circumstances similar to those given.

One would naturally suppose that the individual shunt field connections had not been disturbed, as it is stated that the armature only was required, but it is possible that in some manner the external shunt field leads may have been reversed. In some cases it is necessary to disconnect these leads when dismantling a machine. B. H. might try reversing them.

It may also be possible that the repair shop changed the throw of the bottom leads unintentionally, when repairing the armature. A small machine like this one usually has four poles, with the lead connections spanning one-half the commutator. An armature with, say, 95 commutator bars would connect on leads 1 and 48 or 1 and 49. These figures are obtained by dividing 95 by 2 (one-half of the field coils) and adding either ½ or 1½ to the answer. If the throw were changed from one to the other span the armature would test OK with any kind of test that the repair shop could give, but the machine would not generate if the armature were turning in the same direction as before. In the case of a motor the armature would simply run in the opposite direction. I suggest, therefore, that B. H. try reversing the armature leads, to see if the voltage will build up.

We once turned down the commutator on a 35-kw. generator and found after assembling it that it would not build up the voltage. The natural conclusion was that the terminal leads had in some way been crossed, but changing them in every possible way gave no results. Examining the brushes we found to our surprise that they were touching on only about $\frac{1}{64}$ in. across the face, although to the eye they appeared to be seated properly. After sandpapering the brushes to fit the new curvature of the commutator the generator built up voltage normally.

From the fact that when the fields of B. H.'s machine are separately excited two 60-watt lamps can be lighted, but no heavier load handled, I believe that improperly-seated brushes may be the cause of the trouble, as a load of any magnitude would kill the voltage.

It may be interesting to note that the machine mentioned above had always required running at maximum speed for a minute or so before it would generate. We found that one shunt and one compound lead had been used as a line. Although this scheme is satisfactory with a motor, it should not be used with a generator, as it makes the shunt field current go through the series field before energizing the shunt field. As the armature generates only 6 or 8 volts from the residual magnetism in the polepieces, the resistance of the series field may tend to keep the voltage from building up.

It is always good policy to connect the shunt, compound, and one armature lead to one post, so that the shunt fields are across the brush-holders and are energized at once. The other compound lead is then used for a line.

Peoria, Ill. GEO. D. RINGNESS.

INDUSTRIAL ENGINEERING'S DATA SHEETS

Motor Wiring Tables

(Continued from the December issue)

DIRECT-CURRENT MOTORS

Voltage	Hp.	Full load Amperes	Wire size Gage No. or circular mils			Conduit size for r. c. wire	Running protection		Max. rating branch circuit fuses Amperes	Voltage drop per 100 ft. (single distance) r. c. wire Percent
			Rubber covered	Varnished cambric	Slow-burning		Max. fuse rating Amperes	Max. setting time limit protect-ive device Amperes		
115	½	4.5	14	14	14	½	6*	5.75	15	2.1
	¾	6.5	14	14	14	½	10*	8.25	15	3.0
	1	8.4	14	14	14	½	12*	10.50	15	3.8
	1½	12.5	12	14	14	½	20*	15.75	20	3.6
	2	16.1	12	12	14	½	20*	20.25	25	4.6
	3	23.0	8	10	10	¾	30	29.00	35	2.6
	5	40	6	6	8	1	50	50.0	60	2.9
	7½	58	3	4	4	1¼	70	72.5	90	2.1
	10	75	1	3	3	1½	100	94.0	125	1.7
	15	112	00	0	1	2	150	140.0	175	1.6
	20	140	000	00	0	2	175	175.0	225	1.6
	25	185	250,000	0000	000	2½	250	231.0	300	1.4
	30	220	300,000	250,000	000	2½	300	275	350	1.4
	40	294	500,000	400,000	300,000	3	400	368	450	1.1
	50	364	600,000	500,000	350,000	3	450	455	600	1.1
	60	436	800,000	600,000	500,000	3½	600	545	654**	1.0
	75	540	1,100,000	900,000	600,000	4	....	675	810**	0.92
230	½	2.3	14	14	14	½	3*	3.00	15	0.53
	¾	3.3	14	14	14	½	6*	4.25	15	0.76
	1	4.2	14	14	14	½	6*	5.25	15	0.96
	1½	6.3	14	14	14	½	8*	8.00	15	1.4
	2	8.3	14	14	14	½	12*	10.50	15	1.9
	3	12.3	12	14	14	½	20	15.50	20	1.8
	5	19.8	10	12	12	¾	25	24.75	30	1.8
	7½	28.7	6	8	8	1	40	36.00	45	1.0
	10	38.0	6	6	8	1	50	47.50	60	1.4

*Motors of 2 hp. or less may be protected by the branch circuit fuses only. N.E.C. 808-a, exception (1).
**Circuit-breaker settings. Fuses not permitted. N.E.C. 805-1 808-a, exception (5).

INDUSTRIAL ENGINEERING'S DATA SHEETS

Motor Wiring Tables

(Continued from the preceding page)

DIRECT-CURRENT MOTORS

Voltage	Hp.	Full load Amperes	Wire size Gage No. or circular mills			Conduit size for r. c. wire	Running protection		Max. rating branch circuit fuses Amperes	Voltage drop per 100 ft. (single distance) r. c. wire Percent
			Rubber covered	Varnished cambric	Slow-burning		Max. fuse rating Amperes	Max. setting time limit protective device Amperes		
	15	56	4	4	6	1¼	70	70.0	90	1.3
	20	74	1	3	3	1½	90	92.5	125	0.83
	25	92	0	1	2	1½	125	115.0	150	0.82
	30	110	00	0	1	2	150	137.5	175	0.78
230	40	146	0000	000	0	2	200	182.5	225	0.65
	50	180	0000	0000	00	2	225	225.0	300	0.80
	60	215	300,000	0000	000	2½	300	269	350	0.67
	75	268	500,000	350,000	250,000	3	350	335	400	0.50
	100	357	600,000	500,000	350,000	3	450	446	600	0.56
	125	443	800,000	700,000	500,000	3½	600	554	665**	0.52
	¾	1.4	14	14	14	½	2*	1.75	15	0.13
	1	1.7	14	14	14	½	3*	2.25	15	0.16
	1½	2.6	14	14	14	½	4*	3.25	15	0.25
	2	3.4	14	14	14	½	6*	4.25	15	0.33
	3	5.0	14	14	14	½	8	6.25	15	0.48
	5	8.2	14	14	14	½	12	10.25	15	0.78
	7½	12	14	14	14	½	15	15.0	20	1.15
	10	16	12	12	14	½	20	20.0	25	0.96
	15	23	8	10	10	¾	30	29.0	35	0.55
550	20	30	6	8	8	1	40	37.5	45	0.45
	25	38	6	6	8	1	50	47.5	60	0.57
	30	45	4	6	6	1¼	60	56.5	70	0.42
	40	61	3	4	4	1¼	80	76.5	100	0.46
	50	75	1	3	3	1½	100	94.0	125	0.35
	60	90	0	1	2	1½	110	112.5	150	0.34
	75	111	00	0	1	2	150	139.0	175	0.33
	100	146	0000	000	0	2	200	182.5	225	0.27
	125	184	250,000	0000	000	2½	250	230.0	300	0.29
	150	220	300,000	250,000	000	2½	300	275	350	0.29
	200	295	500,000	400,000	300,000	3	400	369	450	0.23

*Motors of 2 hp. or less may be protected by the branch circuit fuses only. N.E.C. 808-a, exception (1).
**Circuit-breaker settings. Fuses not permitted. N.E.C. 805-1, 808-a, exception (5).

EQUIPMENT NEWS

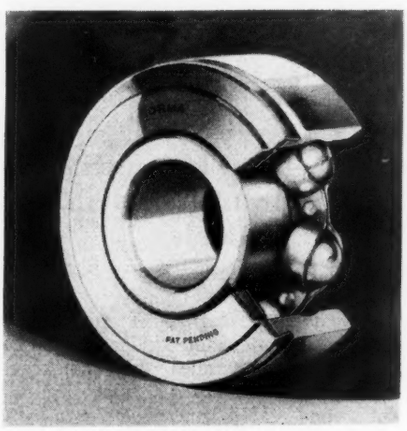
Industrial plant executives concerned with the selection and operation of mechanical and electrical equipment will be interested in these devices, which are designed to improve plant operation or reduce operating and maintenance costs.

Norma-Hoffman Felt-Protected Ball Bearings

KNOWN as "GreaSeal," the line of closed-type ball bearings, introduced by the Norma-Hoffman Bearings Corporation, Stamford, Conn., incorporates a felt closure as an inherent part of the bearing itself. Units are self sealed, grease packed, and dirt and moisture proof.

Bearings are of steel with a solid outer ring of full single-row width; the inner ring is extended on the seal side and slightly inset on the other.

Inner and outer ring sections have the same uniform proportions as standard closed types of equivalent bore and outside diameter; the internal characteristics are also identical so that radial and thrust capacities are respectively the same, size for size.

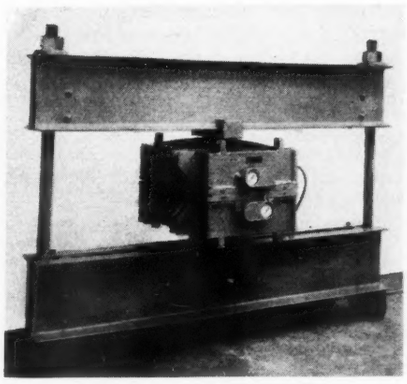


The "GreaSeal" itself, which comprises two dished plates with a felt washer interposed, is rigidly fixed to the outer ring of the bearing, but is not in contact with the housing.

Heintz Vulcanizer for Rubber Belts

JAMES C. HEINTZ & COMPANY, 3738 West 143 St., Cleveland, Ohio, announces a portable vulcanizer for repairing and splicing rubber belts.

Injuries in belts up to 60 in. in width may be repaired in the field and vulcanized with this outfit in the same manner and with the same methods as are used in the factory. Splices up to 21 in. in width may also be made.

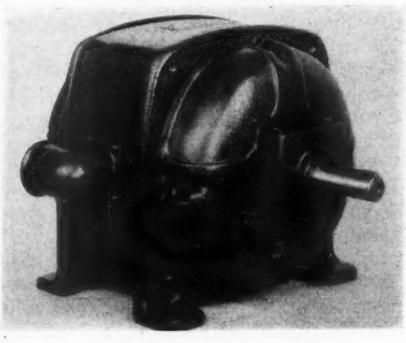


The vulcanizer is electrically heated and equipped with automatic temperature control. Repairs are made under a pressure of 100 lb. per sq. inch.

General Electric Reversing Motor

A LINE of single-phase, repulsion induction motors capable of frequent reversal, designated Type SCA, has been announced by the General Electric Company, Schenectady, N. Y. These motors have the same appearance as the Type SCR general-purpose, single-phase motors, and are mechanically interchangeable in corresponding horsepower and speed ratings of that type.

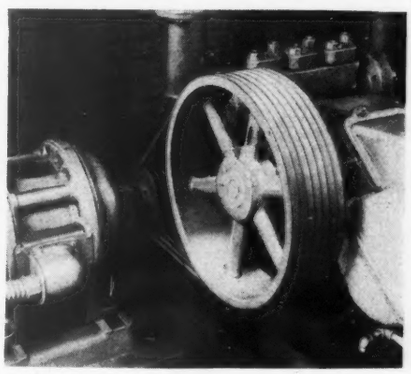
Available ratings range from ¾ to 5 hp. at 1,800 r.p.m., and from ½ to 2 hp. at 1,200 r.p.m. All mechanical modifications which may be applied to the general-purpose SCR motors are equally applicable to the Type SCA motors.



Control equipment consists of a full-voltage, three-pole reversing switch which may be either manually or magnetically operated.

Medart V-Belt Drives

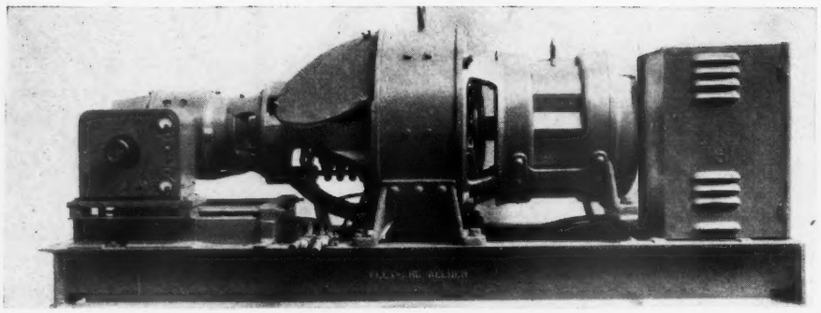
COMPLETE V-belt drives, introduced by The Medart Company, 3500 DeKalb St., St. Louis, Mo., consist of two grooved sheaves and a set of endless belts, the number of grooves and belts depending on the size of the installation and the horsepower to be transmitted. Drives are made to accommodate ratios ranging from 1:1 to 11:1. Either high-speed or low-speed types are available.



Units may be installed either horizontally or vertically or at any angle between these positions.

Westinghouse Welding Unit

A SINGLE-OPERATOR, 600-amp. welder that is available with electric motor or gasoline-engine drive in stationary or portable models, has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The machine is designed to



handle various sizes of electrodes, including bare and special coated rods requiring current values up to 750 amperes.

Motor and generator have a common shaft with two bracket-type bearings. A two-bearing exciter is overhung from the commutator end of the main generator. The Flexactor, which provides a non-surge welding circuit, is mounted on the welded channel base under the exciter. The control devices which consist of a single-dial field rheostat for adjusting the welding current, an ammeter, a voltmeter, and a starter push-button for motor drive, are all inclosed in a sheet-metal cabinet mounted beside the welding outlet leads.

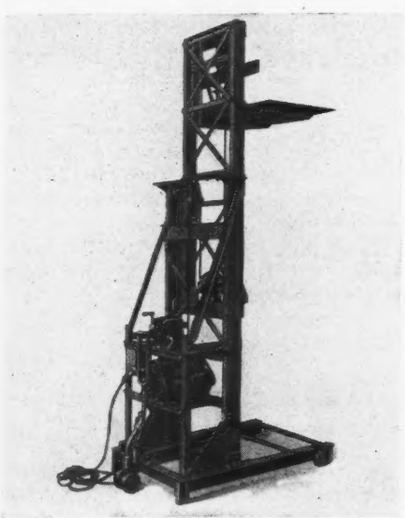
The main generator operates on the variable-voltage, constant-current principle with a separately excited shunt field and a bucking series field.

Overall dimensions of the stationary motor-driven unit illustrated are 96x28x 40 in. It weighs approximately 4,500 lb. net.

Economy Lifting Machines

A LINE of ball bearing equipped lifting machines has been announced by the Economy Engineering Company, 2653 West Van Buren St., Chicago, Ill. Both hand- and power-operated, plain and telescoping machines are included in the line. Ball bearings are used throughout the gearing and in the sheave and platform frame wheels. On the telescoping units ball bearings are also used in the sliding frame wheels.

Spur-geared hoisting units are used exclusively, that on the hand-power unit being fully guarded, and lubricated with



grease. The electric unit is contained in a metal case and runs in a bath of oil. The former has a self-acting gravity brake while the latter has a dual system, both brakes working automatically to hold the load wherever desired, and to prevent falling of the platform in case of current failure.

Electric machines are equipped with motors of ½, 1, 2, and 3 hp. or more, depending on the speed of operation needed. All are controlled by means of a single-lever drum switch. A lever attached to the rear of the controller shaft operates the service brake.

Automatic limit stops prevent overtravel of platform by returning control lever to the "stop" position, thereby stopping the motor and setting the brake.

An Alemite lubricating system is used on the guide, sheave and base wheels as well as on the hand-power hoisting unit.

Pease Sheet Dryer

THE "Junior" sheet dryer, made by The C. F. Pease Company, 813 North Franklin St., Chicago, Ill., is for blueprints, negatives, blue-line and brown-line prints up to 24 in. wide. When a chromium-plated cylinder is used, the machine may also be used for drying photo prints.

Prints are fed into the dryer over a brass scraper rod and up an inclined feed table which drains the water away from the drying drum and prevents steam pockets and creased prints. Surplus water is collected in an adjustable drip pan with drain plug located directly beneath the feed table. This pan can be raised or lowered as required for handling either long or short prints. After drying, prints are automatically returned to an adjustable tray at the front of the machine, and, when especially long prints are being run, the tray can be pushed back out of the way.

The revolving copper drying drum can be furnished with either gas or electric heating elements.

The machine is constructed with an angle-iron frame finished in olive-green enamel. It is equipped with a ⅛-hp. motor and a variable-speed gear drive for two speeds, either 2 or 3 f.p.m.

A hand screw regulator is used for controlling the canvas band. Overall height is 5 ft. 3 in. and the floor space is 3 ft. 5 in. by 3 ft. 6 inches.

General Insulated Aluminum Wires and Cables

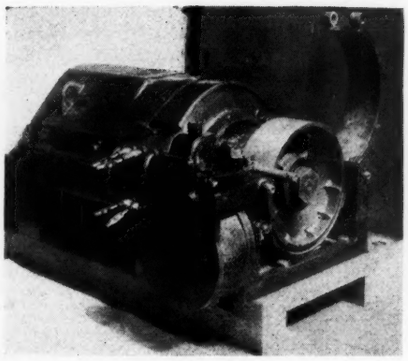
GENERAL Cable Corporation, New York, N. Y., announces a line of insulated aluminum wires and cables under the trade name "Alectral." The initial group includes such constructions as network cable, non-metallic underground cable, insulated line wire, tree wire, armored cables, magnet wire, starter cable, and car wiring cable.

Connections will be made by applying high pressures to sleeves by means of a specially designed hydraulic press.

General Electric Magnet-Operated Brakes

THE General Electric Company, Schenectady, N. Y., announces a line of band-type, clapper-magnet-operated brakes, designated CR-9517, for d.c. motors in heavy-duty service.

This brake operates in the same manner as the external contracting, band-type automobile brake. It is applied by



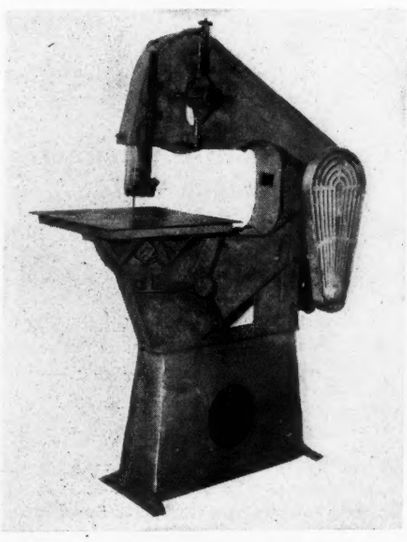
a spring and released by a magnet. It can either be connected to operate in synchronism with the starting and stopping of the motor, or to operate independently. One type uses a series-wound coil and the other, a shunt-wound coil. In the case of independent action, the motor control is provided with a drift point which takes power off the motor, but does not apply the brake.

One size of bolt heads and nuts is used for all brake adjustments, making it necessary to use but one size open-end wrench. Coil terminals are secured to the magnet frame.

Coil magnets can be mounted so that terminals can be brought out on either side of the brake. The coils are form wound, vacuum treated and compounded in the magnet frame, thus keeping out moisture. Balanced steel wheels are used. Brake bands are interchangeable, both top and bottom.

De Walt Band Saw

ALL-STEEL, fabricated band saws have been announced by the De Walt Products Corporation, Lancaster, Pa. These machines are built entirely by electric welding, and are being made in two types; the three-wheel unit and the two-wheel unit.



The 16-in. unit has two wheels; the 24- and 30-in. models are three-wheel machines. All models employ 16½-in. aluminum wheels, mechanically balanced and mounted on Timken bearings with a tracking device for lining the saw blade.

It is claimed that the use of three-pulley wheels makes possible greater throat clearance. Band-saw track and wheels are all contained in one frame, completely inclosing all running parts, except that portion of the saw blade used in the cut. Motors of ½, ¾, or 1 hp. with V-type pulley and belt are available.

Murdock Air Valve

IT is claimed that the air valve, called the Q.O.C., introduced by the Murdock Manufacturing and Supply Company, Cincinnati, Ohio, cannot be left

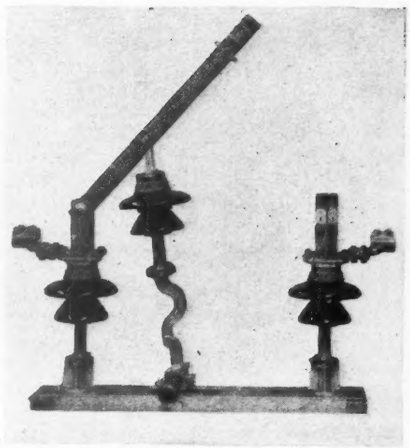
partly open and does not require grinding.

The valve is either full on or full off. Vertical action is said to eliminate all friction at the valve seat. The valve is closed by air-pressure, but an auxiliary spring is also included in case the unit is installed in a horizontal or diagonal position.

Delta-Star Disconnecting Switches

A LINE of gang-operated, outdoor disconnecting switches of the push-rod type has been announced by the Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Ill. A single-pole, 25-kv., 1,200-amp element is pictured.

Multi-section contacts are of the full-floating type. To the double-section



blade is pivoted an insulator controlled by the operating pipe connecting all three elements.

Conductor terminal lugs are of the four-bolt and clamp type for use with various forms of conductors and buses.

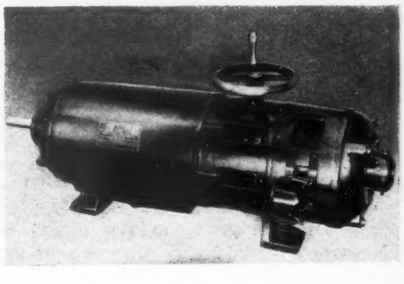
Stephens-Adamson Variable-Speed Drive

A VARIABLE-speed drive which combines motor, speed changer, speed reducer and control in a single housing has been announced by the Stephens-Adamson Manufacturing Company, Aurora, Ill. It is made in sizes to deliver from ¼ to 7½ hp. and is recommended for driving feeders, assembly conveyors, mixers, machine tools, and other applications where a variable-speed drive is needed.

The motor section is usually wound to operate at 1,200 r.p.m. and the drive will deliver input at any speed between 24 and 144 r.p.m. or 120 and 720 r.p.m. Output speed is increased or decreased while the machine is in motion by turning the small hand wheel on top of the housing.

Mechanism is inclosed in a single housing, covering all moving parts except the output shaft, thus protecting both machine and operators from possible injury.

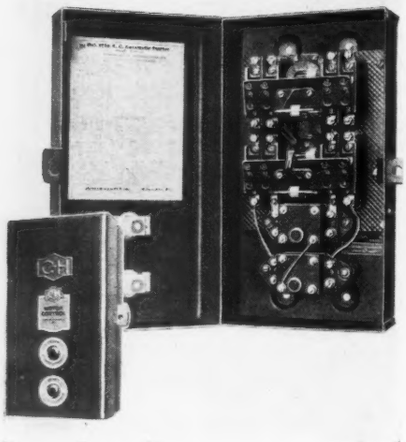
The drive is essentially the standard "JFS" variable-speed reducer with the housing modified to take the body of an electric motor. The motor armature shaft is extended and forms the high-speed shaft of the speed changer.



Cutler-Hammer Multi-Speed A. C. Motor Starters

A LINE of inclosed automatic motor starters for two-speed, separate-winding type, squirrel-cage motors is announced by Cutler-Hammer, Inc., 150 12th St., Milwaukee, Wis. These starters, known as Bulletin 9736, are of the across-the-line type. The windings are connected directly to the line and are protected against dangerous overloads by means of thermal overload relays. A push-button master switch, with "stop," "low," and "high" buttons, is used for remote control.

Starters can be furnished in three types: for starting on either winding, with sequence compelling feature, or with automatic sequence control relay. When starting on either winding, depressing either the "low" or "high"

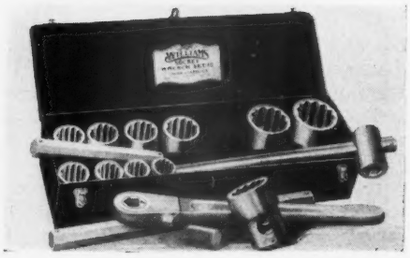


button starts the motor on the respective low- or high-speed winding. With the sequence compelling features, the motor is always started first at low speed. Depressing the "high" button will not start the motor. The automatic sequence control relay insures that the motor will always start at low speed and pass the high speed automatically if the "high" button is depressed. All three types provide for the transfer from one speed to the other.

The mechanism, which consists of two magnetic contactors mechanically interlocked and two sets of thermal overload relays (one for each winding), is mounted in a split-type inclosing case which, when opened, provides easy access to the various operating parts.

Williams Socket Wrenches

A COMPLETE line of detachable socket wrenches for industrial service, announced by J. H. Williams & Company, Buffalo, N. Y., consists of



three socket patterns with an assortment of handles and parts for each.

The standard model, with ½-in. square drive, includes sockets with double-hex, hex and square openings up to 1 in. The heavy-duty pattern with ¾-in. square drive has double-hex openings from ⅞ to 1⅛ in. The third pattern, for extra-heavy duty, has a 1-in. hex drive and sockets with double-hex openings from 1 1/16 to 2⅜ inches.

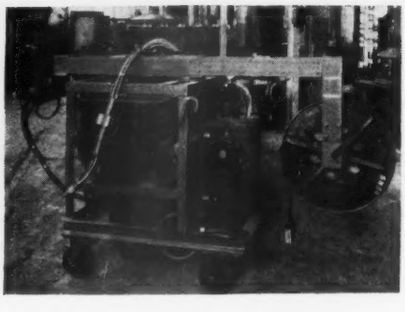
All sockets, handles and accessories are chrome plated over nickel and are guaranteed against breakage.

General Electric Semi-Automatic Welder

IMPROVED, portable, semi-automatic arc welding equipment announced by the General Electric Company, Schenectady, N. Y., can be used for either open- or shielded-arc welding. A simple adjustment is all that is necessary to make the conversion.

Equipment consists of a welding head for feeding the electrode, an inclosed line contactor with interlock, and a field rheostat for controlling the motor on the welding head, as well as a welding tool and a lead for directing the electrode toward the work. The welding head is a motor-driven, wire-feeding device to supply electrode wire continuously to the arc. Wire is drawn from a reel by means of a pair of geared feed rollers propelled through a train of gears by an adjustable-speed, 60-volt, d.c. motor. The head is equipped with a gear shift for obtaining approximately the required rate of wire speed, the final adjustment is made by means of the motor field rheostat.

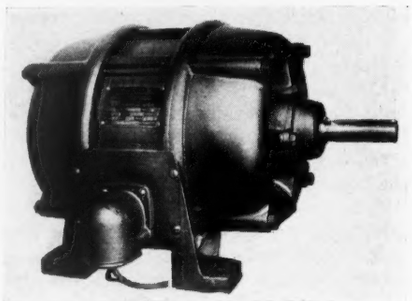
The welding tool and lead consists of a 10-ft. insulated flexible conduit with handle and nozzle so that the operator can direct the electrode at the work. A tumbler switch in the handle permits the operator to close or open the line contactor and start the feed motor in operation. When it is desired to weld with the shielded arc it is merely necessary to change two nozzle accessories.



Use of the shielded arc, which surrounds the weld with an atmosphere of hydrogen, minimizes the formation of harmful oxides and nitrides at the weld, and produces, it is stated, a more ductile joint.

Ideal "Unit Type" Motor

CALLED "Unit Type" because it is constructed of standardized rotor and stator parts, the motor introduced by the Ideal Electric and Manufacturing

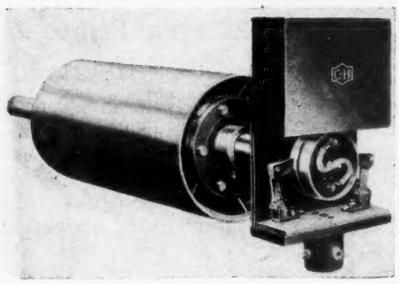


Company, Mansfield, Ohio, is designed so that all loads and shocks are carried directly to the motor supports. The motor feet are placed on the bearing brackets and, since the brackets support themselves, the only mechanical load on the stator is the motor torque.

Interchangeable ball, roller or sleeve bearings may be used, but anti-friction bearings are supplied as standard equipment. The ball and roller bearings are of the cartridge type. Sleeve bearing housings can be rotated for wall or ceiling mounting without removing the bearing brackets. Zerk fittings with an automatic seal are used to supply grease under pressure.

Cutler-Hammer Magnetic Separator Pulley

SIMPLE construction and better wearing qualities are two of the features claimed for the Type "W" magnetic separator pulley announced by Cutler-Hammer, Inc., 150 12th St., Milwaukee, Wis. The pulley has only three major parts—a machined cast-steel spool, the magnet coils and a coil shield with the necessary insulation. Magnet coils are wound on the steel spool and vacuum impregnated to make them moisture proof. The coil shield is then welded to the spool so that it



completely incloses the magnet coils.

The commutating mechanism, which conducts the current to the magnet coils, is mounted on one end of the pulley shaft. Brass collector rings and carbon brushes assure good contact at all times. A dust-proof cover protects the commutating mechanism from dust and other flying particles and protects operators from accidental contact with live parts.

Pulleys are made 12 in. in diameter, and in six lengths for belt widths varying from 12 to 30 inches.

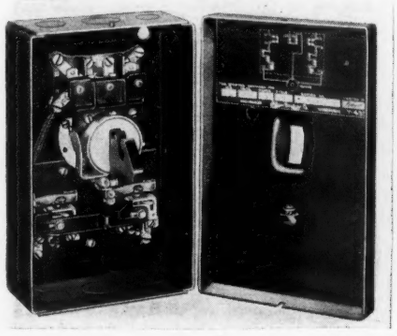
John A. Roebling's Sons Company Succeeds New Jersey Wire Cloth Company

ON and after Jan. 1, 1931, the corporate existence of The New Jersey Wire Cloth Company, Trenton, N. J., will cease. The business will be continued by the John A. Roebling's Sons Company of which it is a subsidiary.

Sale and distribution of wire cloth, wire netting, wire fencing, wire lath and wire work will be continued through the parent company at Trenton and through the Roebling branches.

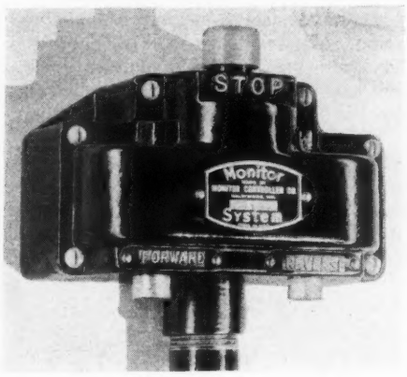
Allen-Bradley Hand-Operated A. C. Starter

THE Allen-Bradley Company, 1311 South First St., Milwaukee, Wis., announces a hand-operated a.c. starting switch with overload breakers. This starter, designated Bulletin 609, handles all motors up to 3 hp., 110 volts; 5 hp., 220 volts; and 7½ hp., 440-550 volts. Overload breakers operating on the soldered ratchet principle eliminate the maintenance of thermal plugs and fuses. Resetting is accomplished by means of a lever, without opening the switch cover. The starting lever has a safety interlock which prevents the cover from being removed unless the lever is in the off position. The switch can be padlocked in the open position if required.



Monitor Push-Button Master Station

AN addition to its line of control switches, an Ironclad push-button master station, has been announced by the Monitor Controller Company, Baltimore, Md. Available for use on either



a.c. or d.c. circuits, this station provides forward and reverse momentary contact control, and is particularly suited to machine service.

Forward and reverse buttons are in a protected position at the bottom of the case. The stop button is on top, also protected, yet easy to operate. This arrangement is said to facilitate quick-action inching in either direction.

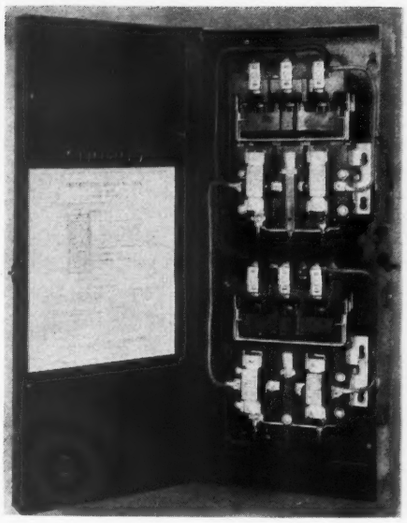
Fixed contacts and wiring are carried in the base. The push buttons are in the cover.

Condit Motor Starter

A REVERSING, across-the-line, air motor starter, known as Type A-30-R,, has been introduced by the Condit Electrical Manufacturing Corporation, Boston,, Mass., for the control and protection of squirrel-cage induction motors.

The unit consists of two of the Type A-30, arc-prevention motor starters mounted in an inclosing case and mechanically interlocked so that only one starter can be in the closed position at one time.

Both starters are equipped with thermal relays for time-lag overload protection. They are furnished for push-button control up to 20 hp., 550 and 440 volts; 15 hp., 220 volts; and 7½ hp., 110 volts.

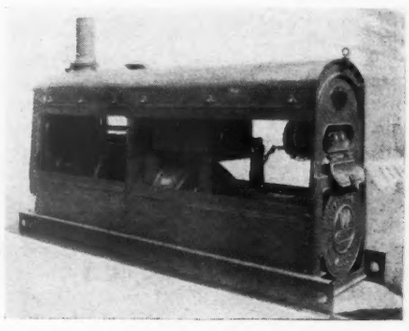


Westinghouse Engine-Driven Welder

A SINGLE-OPERATOR, engine-driven, 600-amp. welder for pipe-line welding has been placed on the market by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The welding generator is of the variable-voltage, constant-current type operating at 1,450 r.p.m., and provides welding current up to 750 amperes.

While the machine is designed primarily for use with high-speed, high-current, coated electrodes, equally good operating characteristics and arc stability may be had on the low-current ranges with small electrodes. The machine is adapted for severe field service where sustained loads and high currents are required over long periods.

As the main generator frame fits directly into the engine flywheel housing, the use of a single-bearing, flexibly coupled generator was made possible. An over-size exciter is overhung from the main generator bracket for separately exciting the welding generator shunt field and for furnishing auxiliary

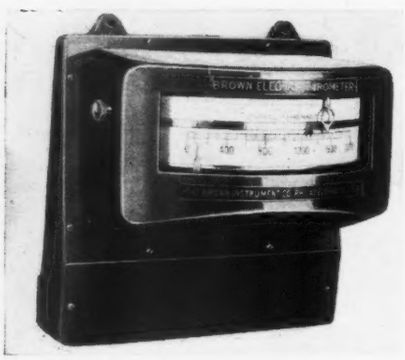


power. The generator control devices, consisting of a single dial rheostat, an ammeter, and a voltmeter, are mounted on the rear panel of the set.

Its driving unit consists of a six-cylinder gasoline engine with an S.A.E. rating of 51.2 and 83 brake hp. at 1,450 r.p.m. Other equipment includes a 25-gal. gas tank, a Pierce governor, an Eisemann magneto, an air cleaner, an oil filter and a protective radiator guard. Approximate net weight is 5,000 pounds.

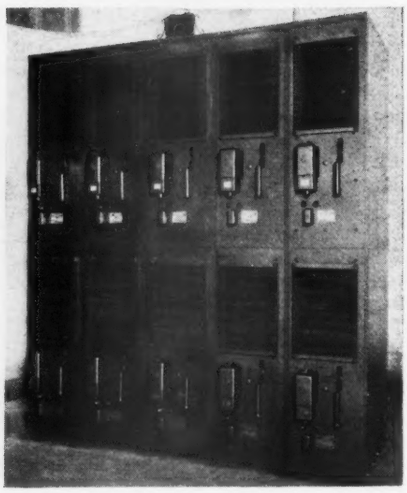
Brown Indicating Pyrometer Controller

MODEL 801 indicating pyrometer controller, announced by the Brown Instrument Company, Philadelphia, Pa., can be supplied as an automatic controller pyrometer, resistance thermometer, tachometer or CO_2 meter. The features claimed for this instrument are: reading may be taken directly from a 6-in. scale; index on scale for setting to an exact control point; motor and wiring terminals inclosed; automatic internal compensation, eliminating cold-junction errors when instrument is supplied as a pyrometer.



General Electric Metal-Inclosed Switchgear

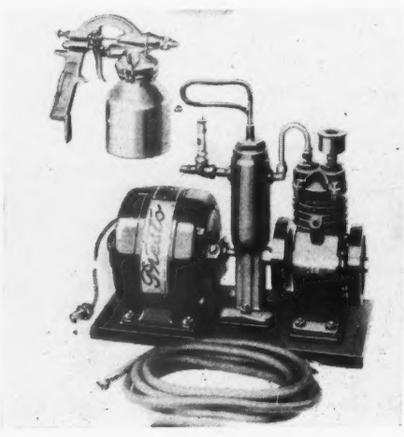
IN the metal-inclosed switchgear of the draw-out type, designed for 600-volt operation, announced by the General Electric Company, Schenectady, N. Y., the units are mounted side by side. Each includes a double-tier stationary element and two removable circuit-breaker elements. Electrically or manually operated, trip-free, air circuit breakers, or oil circuit breakers in ratings up to 7,500 volts, 600 amp., or 600 volts, 800 amp., can be used. This type of gear can be adapted to a single or double-bus, double-breaker arrangement. Incoming connections can be brought to the bus by inserting an incoming line compartment in any desired location in the line of units.



Stretcher-leveled steel panels are mounted on removable elements. The panel is provided with insulating levers, while the rear plates of the station elements have screened openings for ventilation. Interlocks securely hold the removable element in the operating position and automatically trip the circuit breaker when the removable element is withdrawn or inserted. The removable element can be withdrawn to a "test position," where the connections remake and the main disconnecting devices are separated, or it can be removed and a spare unit inserted.

Metal Specialties Spray-Painting Outfit

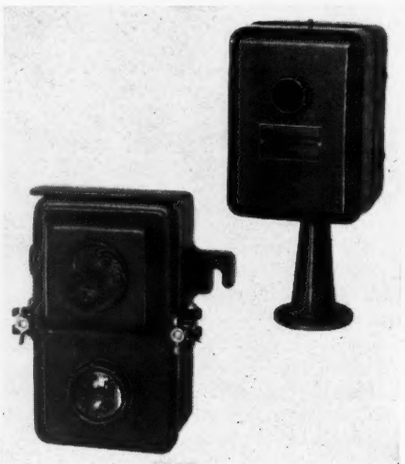
PRESTO Model 126 is the latest addition to the line of spray-painting equipment made by the Metal Specialties Manufacturing Company, 3200 Carroll Ave., Chicago, Ill. It is a portable, direct-drive outfit for applying both light and heavy materials. The spray gun is of the pressure-feed type. The size of the spray and the amount of material applied can be controlled from the trigger. The outfit includes compressor, air conditioner, electric motor, pressure-feed spray gun and hose.



General Electric Photo-Electric Equipment

SEVERAL items have been added by the General Electric Company, Schenectady, N. Y., to its line of photo-electric relays for the control of industrial machinery and other devices. In addition to the original unit, designated CR-7505-A-2, an a.c. relay, there are now introduced the following: a d.c. relay, designated CR-7505-B-1; an outdoor, weatherproof, a.c. relay, designated CR-7505-C-2; an interior light control unit,, designated CR-7505-D-1; a.c. and d.c. interior measuring devices, designated CR-7505-E-1 and F-1, respectively; a.c. or d.c. indoor light source, designed CR-7500-A-1, and an outdoor, weatherproof a.c. light source, designated CR-7500-B-1.

The d.c. relay can be supplied for any standard, commercial voltage. It is of two-unit construction, one unit being the photo-electric tube and the other, the relay box.



The CR-7505-C-2 relay is a unit similar to the A-1 and B-2 (a.c. and d.c.) types, but is inclosed in a cast-iron case for outdoor use. It is entirely self-contained, with both the relay mechanism and the photo-electric tube with window in the same case, and, so far, is announced for a.c. circuits only.

The interior light control unit is a photo-electric unit for turning inside lights on or off according to the amount of illumination from the outside.

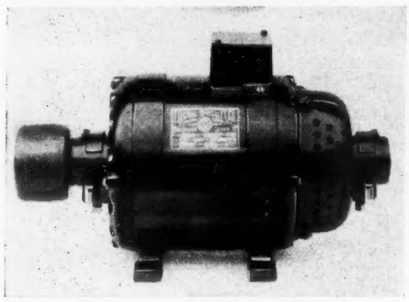
The measuring devices are similar to the two-unit relays, except that the relays themselves are omitted. Arrangement is made, instead, for connecting in the output circuit an indicating or recording instrument for experimental work in measuring illumination, translucencies of liquids and so forth.

The two light sources can be used in connection with standard relay units to provide light up to a distance of 25 ft. and where the control is to function as a result of the interruption of that light.

The outdoor light source is of weatherproof construction and is inclosed in a cast-aluminum case. It is designed for operation on a.c. circuits, and has a 110/220- to 6-volt transformer included in the unit.

Electric Specialty Motors

SYNCHRONOUS, commutator motors of improved design have been announced by the Electric Specialty Company, Stamford, Conn. Units are now made in sizes ranging from ⅛ to

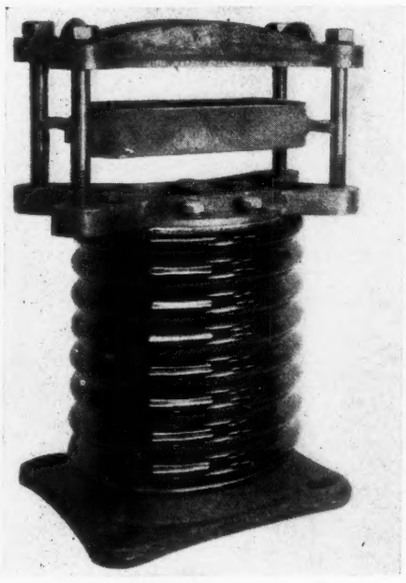


3 hp. The announcement states that the performance of this equipment is in compliance with the recommendations of the Joint Committee on Fractional Horsepower Motors.

Champion Heavy-Duty Bus Support

THE Champion Switch Company, Kenova, W. Va., has developed a 25-kv., indoor bus support for use on heavy-capacity buses.

Bus clamps and spacer are made of non-magnetic alloy, and the supporting base is of drop-forged steel. The solid, one-piece insulator is 6 in. in diameter. The sustaining force at the center line of the bus is 6,000 pounds.



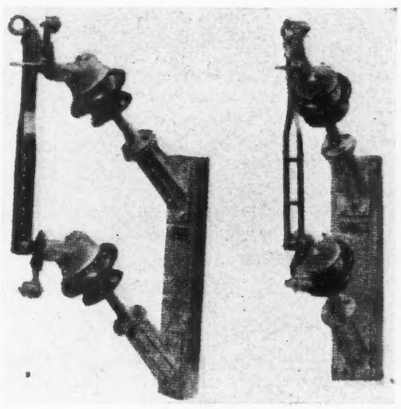
Electric Machinery Neon Sign Capacitor

ANNOUNCEMENT has been made by the Electric Machinery Manufacturing Company, Minneapolis, Minn., of the development of a capacitor for use with Neon signs.

In the oil-filled type, the capacitor-roll elements are immersed in oil and securely inclosed in a leakproof, welded container. Units in kva. capacities of from ¼ to 1 are available.

Delta-Star Disconnecting Switch

SINGLE-POLE disconnecting switches with four-bolt insulator units, safety-lock and solderless, compression-type terminal lugs have been introduced by the Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Ill. Interchangeable parts, high

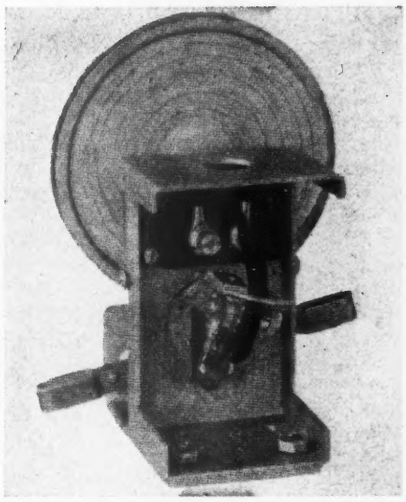


electrical and mechanical characteristics are among the features of the design. This switch is rated 600 amp. at 37 kilowatts.

General Electric Float Switch

USE of a mercury switch as part of a float switch, designated CR-2931-U, announced by the General Electric Company, Schenectady, N. Y., makes the device suitable for use in atmospheres where open-type, mechanical contacts might be subject to corrosion, or where, for other reasons, it is desirable totally to inclose the contact.

The mercury switch used is known as a "Kon-nec-tor" and is a product of the General Electric Vapor Lamp Company. It consists of a hard glass envelope containing a quantity of mercury and having two inleading wires. The envelope is constructed so that when the switch is in the closed position the mercury forms a continuous

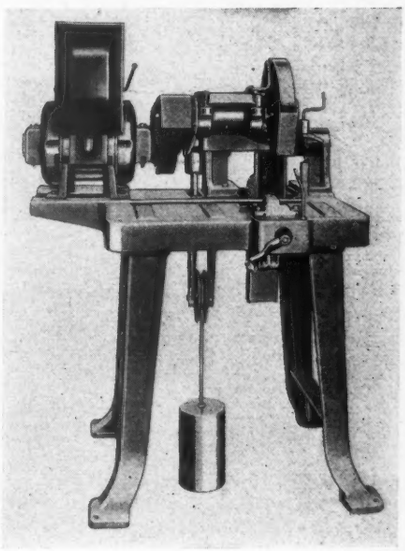


stream from one inleading wire to the other. In the open position, the mercury breaks into two distinct pools so that one of the inleading wires is immersed in each, with an open space between the pools. Thus, circuits are made and broken in the mercury and never between the mercury and either of the inleading wires. The glass envelope is filled with an inert gas which prevents oxidation and the establishment of an arc upon opening a circuit under load.

Campbell Abrasive Cut-Off Machine

THE abrasive cut-off machine introduced by Andrew C. Campbell, Inc., Waterbury, Conn., is made for cutting steel, steel alloys, iron, non-ferrous metals, fiber and other materials.

The handle for operating the disk is arranged so that the operator may use either hand in cutting material. The starting switch is conveniently located on the motor. Belts and the disk are also guarded. A V-belt drive is used.



Trumbull Panelboards

"SAFE-conver-Ti-fuse" is the name given the interchangeable unit panelboard introduced by The Trumbull Electric Manufacturing Company, Plainville, Conn. The construction of this board allows for instantaneous disconnection through removal of the "cap" which in itself contains the fuses. When it is reinserted by a 180-deg. change of position the circuit is off and all parts are completely covered and protected. When the cap is removed the fuses come with it and replacements can be made away from the board. Both caps and sections are of Bakelite and have a handle and a cardholder for identifying the circuit.

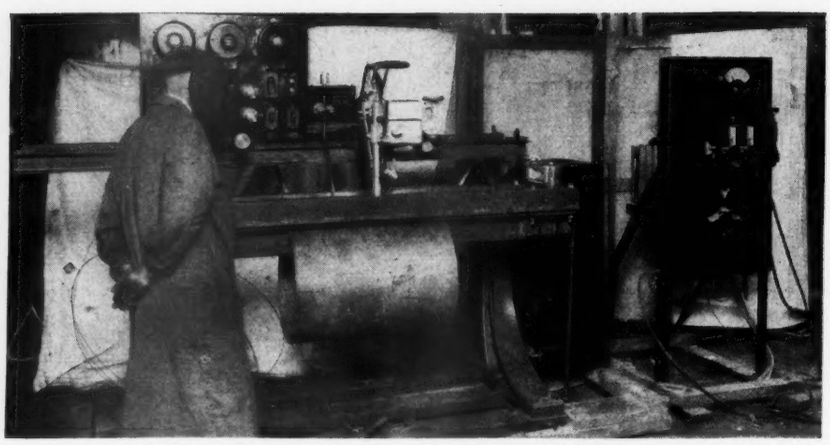
The cabinet front is of steel and is hinged to the side of the box so that access may be had to the panel interior and wiring gutters without removing the box cover.

All copper parts except bus bars and the main lugs are cadmium plated. Panelboards are made in capacities up to 600 amp., 250-volt d.c., or 600-volt a.c. service.

General Electric Automatic Welder

AN automatic welder for atomic hydrogen welding has been announced by the General Electric Company, Schenectady, N. Y. This equipment was designed for longitudinal seam welding of all kinds, and it consists of a clamping mechanism for holding the work, an automatic travel carriage, a welding head and the usual control devices, and other accessories.

Clamping mechanism and travel carriage are of standard types, while the welding head, control, and so on, are of special design to suit the use of atomic hydrogen welding. In addition,



there is an auxiliary device for feeding filler rod into the arc, as the tungsten electrodes used to form the arc are consumed slowly and do not contribute metal to the weld.

In operation, the work is clamped in place in the usual manner. The travel carriage is then set at one end of the seam and the "start" push button is depressed. The remainder of the operation is automatic. With the pressing of the "start" button the line contactor closes, applying power to the equipment and simultaneously opening a valve supplying hydrogen to the arc. The striking of the arc, movement of the travel carriage, and length of the arc are all controlled automatically.

Conveyor Sales Shaker Conveyor Drive

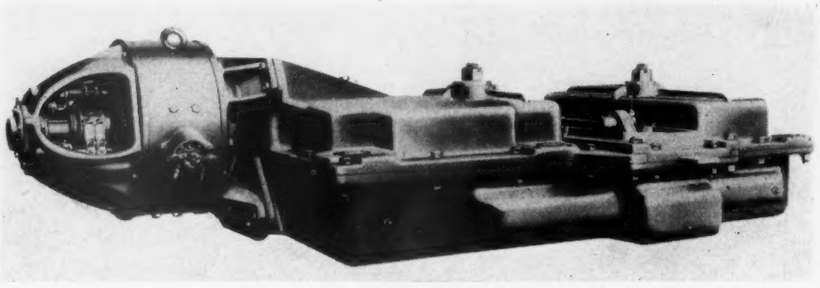
THE shaker conveyor drive, known as C-20, made by the Conveyor Sales Company, New York, N. Y., will be found useful in any industrial plant where bulk granular material must be conveyed for comparatively short distances.

The unit is designed so as to provide the correct relation between acceleration velocity and that of retardation. The mechanism consists of a gear train and cross arm which convert the rotary motion of the motor into reciprocating motion of a cross head which is connected to the conveyor trough. The mechanism is totally inclosed in a heavy, cast-steel case, which also serves as an oil reservoir, and is provided with three separate covers to permit access to any part of the machine.

Four sockets are cast into the top of the case for the reception of ratchet holding jacks. Driving motor is bracket mounted, the necessary pads being cast integral with the case. Motors are rated 20 hp. and are available in either a.c. or d.c. types. Automatic remote control with time-limit acceleration and full protection against overload and under voltage is also provided for the motor.

The construction of the drive is substantially as follows: A pinion on the motor drives a bevel ring gear which is mounted on the same vertical shaft as a main driving pinion. This pinion in turn drives the main gears which are also mounted on vertical shafts; one directly, and the other through an idler gear. The gears are made from heat-treated cast steel, with stub cut teeth, and all shafts are mounted in Timken bearings.

Each main gear is provided with a crank, or wrist pin, which fits in a block sliding in a cross arm located under the gears, the cross arm being supported by circular ribs cast in the base. The cross arm in turn is pivoted on a cross head pin set in the cross head, which slides in bronze guides set in the base. The cross head is pinned to the conveyor trough and both cross head and cross head pin are provided with bronze bushings. Lubrication of the various bearings is provided for by an oil pump located in the case, and driven by an eccentric machined in the primary drive shaft.



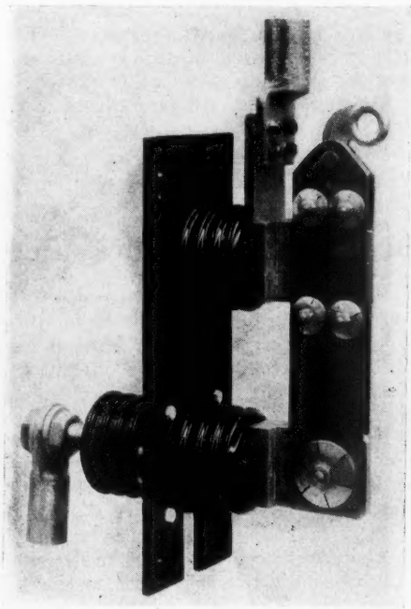
Chicago Pneumatic Quimby Sump Pump

THE Quimby sump pump, introduced by the Chicago Pneumatic Tool Company, 6 East 44th St., New York, is an air-operated pump driven by a Chicago Pneumatic, No. 88 rotary air motor. The pump has a capacity of 100 g.p.m. at a 28-ft. head. Total weight is 44 pounds.

It is particularly adaptable where water must be removed from manholes or pits before work may be started.

Delta-Star Disconnecting Switch

A HIGH-CAPACITY, front and back-connected, indoor-type, single-pole disconnecting switch of 7.5 kv. capacity has been developed by the Delta-Star Electric Company, 2400 Block Fulton St., Chicago, Illinois.

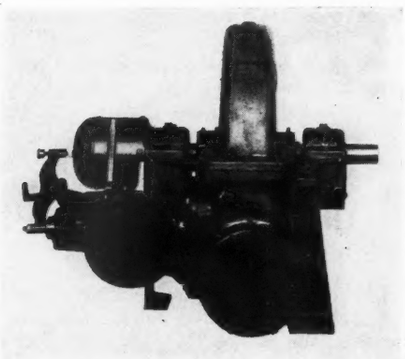


Double tongue-type blades and safety locks are used. The back-connected insulator unit is clamped to the steel base, permitting easy removal or replacement. The steel base is slotted to reduce eddy currents with heavy current flow through the conductor stud.

General Electric Mechanical-Drive Turbine

A MECHANICAL-DRIVE steam turbine, designated Type D-58, for driving fans, pumps, and similar industrial equipment, has been announced by the General Electric Company, Schenectady, N. Y. The turbine is designed for operation at steam pressures up to 250 lb. and speeds between 1,200 and 4,000 r.p.m., with capacities up to approximately 250 hp. It is built only as a single-stage machine.

By limiting the range of conditions under which this turbine will be expected to operate it has been possible to

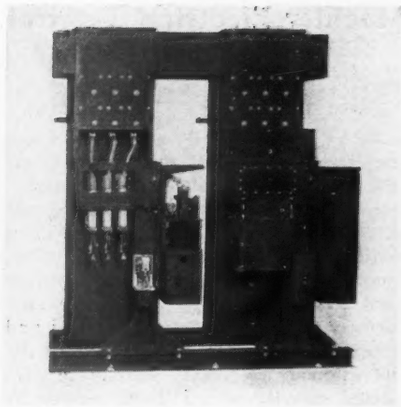


decrease the length and width, and affect a considerable saving in weight. The turbine is supported at the center line to permit expansion without affecting the shaft alignment. It is equipped with speed regulating and emergency governors and is fitted with carbon shaft packing. Pipe connections are made to the lower half of the turbine to facilitate opening for inspection.

Delta-Star Metal-Clad Switchgear

A LINE of unit-type, metal-clad switchgear units for controlling station auxiliaries has been announced by the Delta-Star Electric Company, 2400 Block Fulton St., Chicago, Ill. Each section contains a t.p.s.t. solenoid motor-operated, oil circuit breaker, with three auxiliary switches, and a control relay.

Two sets of three-pole, gang-operated disconnects with barriers between phases and between ground are simultaneously operated so that both close or open at the same time. Interlocks between the oil breaker and disconnects



prevent opening the latter when the oil breaker is closed.

Current transformers, overload relays with calibrating terminals, insulated busbars, and wiring are all mounted in the steel structure. As many units as desired, depending on the number of circuits to be controlled, can be mounted alongside each other.

United States Right-Angle Drill

BUILT with a special right-angle head, the electric drill introduced by the United States Electrical Tool Company, 2490 West 6th St., Cincinnati, Ohio, is particularly adaptable for drilling between studs, joists, and other close places. It accommodates bits 2½ in. or smaller and turns at 210 r.p.m. Hardened, chrome-nickel steel gears, running in grease, and a short-proof trigger switch are among the features.

Maehler Electrical Control Unit

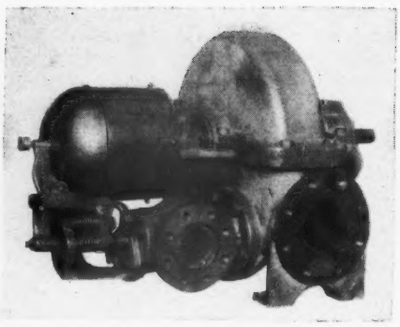
THIS device, introduced by The Paul Maehler Company, 2208 West Lake St., Chicago, Ill., embodies in one unit the functions of the various control devices ordinarily used in connection with oven operation. The cabinet is 20x16x5 in. and contains the main switch, fuses, temperature control valve, automatic mercury actuator, a gas pressure controller, high voltage transformer, time daily control, and red and green flasher lights which indicate the operation at all times. It may be connected directly to a 110-volt circuit by means of a snap switch on the outside of the cabinet.

Inside the cabinet, current is distributed to the various devices through

a jack. The indicating controller, which may be set for any temperature desired, is located on the outside. Adjustable arms provide maximum and minimum range and, when contact is formed with the temperature indicating arm, the electrically operated temperature control valve closes or opens, retarding or increasing the fuel supply of the oven and maintaining the temperature within the desired range.

General Electric Mechanical-Drive Turbine

SMALL mechanical-drive non-condensing steam turbines, bearing the designation D-57, for driving centrifugal pumps, fans, and similar industrial equipment operating at speeds between 1,750 and 3,600 r.p.m., have been announced by the General Electric Company, Schenectady, New York.



These turbines are built only as single-stage machines and have but two rows of revolving buckets. The wheel casing is split horizontally for easy access to the internal parts, and the steam and exhaust pipes are connected to the lower half of the machine.

Mica Insulator "Lamicoid"

AN insulating material of laminated Bakelite known as "Lamicoid" is being made by the Mica Insulator Company, 200 Varick St., New York. It is made in sheets and is available in 16 grades and a variety of finishes.

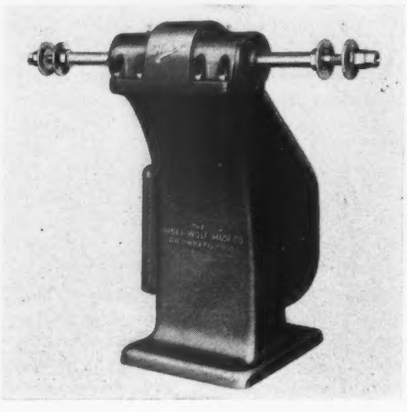
Hisey-Wolf TexDrive Buffer

THE Hisey-Wolf Machine Company, Cincinnati, Ohio, has announced the Model "M" TexDrive buffer, with open type spindle extensions, in three sizes: 3, 5, and 7½ hp. Motor mounting is of the external type with a rigid four-point support.

Motor is ball bearing equipped and has a dovetailed sliding base including gib with the necessary locking screws. Adjustment is made by means of handwheel and feed-screw. By loosening eight bolts, the spindle assembly may be removed from the machine without pulling the spindle through the housing.

Ball bearings are used on each end of the spindle. Dust covers on each end of the bearing housing are provided with labyrinth seals which exclude dust and dirt. The base, which is of gooseneck design, is a one-piece casting.

Lubrication chambers are filled through conveniently located oil cups.



Industrial Controller Manual Starter

ONE of the features of the Class 2510 manual starter introduced by the Industrial Controller Division, Square D Company, Milwaukee, Wis., is that all poles are simultaneously opened with the tripping of either of the two relays. The thermal overload relay protects the motor against excessive current, whether due to operating conditions or single phasing of the line. The starter is reset for operation by pressing the button extending through the front cover.

Another feature of this starter is its trip-free handle which prevents blocking of the switch closed against an overload.

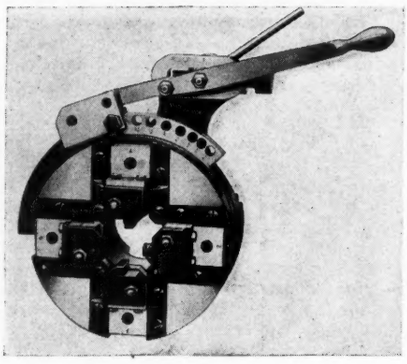
The three-phase ratings of this starter are 5 hp., 220 volts and 7½ hp., 440-550 volts.

Bignall & Keeler Threading Diehead

AMONG the features claimed for the threading diehead, known as "Bikeko," introduced by the Bignall & Keeler Machine Works, Edwardsville, Ill., are the following:

It is simple and easy to operate; one upward movement of the die lever lifts all the dies clear of the pipe and coupling.

Positive lock on the screw adjustment insures accurate duplicate threads after the adjustment is once set for a given size. The pitch adjusting screw



gives positive adjustment for standard or special sizes.

Die block is made in two sections—the upper section, which holds the die, is provided with a screw adjustment for increasing or reducing the clearance on each die.

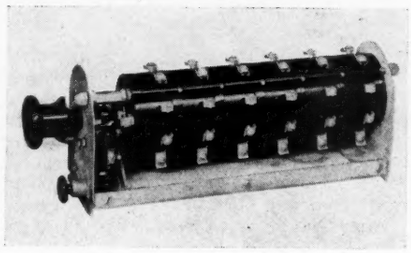
Die slides have long travel, allowing one set of dies to handle all sizes within the capacity of the head, as long as the taper and thread remain the same. One die can be replaced without renewing the entire set.

General Electric Switches for Changeable-Pole Motors

TWO switches for use with multi-speed, changeable-pole motors have been announced by the General Electric Company, Schenectady, N. Y. These bear the designations CR-2960-SY-108 and SY-113, the first being for use with smaller and the second, for larger sizes of motors. When used with multi-speed, squirrel-cage induction motors, they permit obtaining different speeds by changing the polar grouping of the stator coils.

The switches can be used with two-, three- or four-speed motors for constant-horsepower or constant-torque service without change in mechanical construction.

In operation the speed point is selected by turning the knob handle to the desired position. Depressing the knob completes the main circuits and then picks up the magnetic line switch through the momentary disk contacts. The holding interlock is then closed and the switch latched in this position.



Pressing the stop button trips the holding interlock, dropping out the magnetic switch and then opens the main contacts. Undervoltage protection is thus provided between speed points.

Borden No. 102 Wheel Cutter

THE Beaver No. 102 wheel cutter, announced by The Borden Company, Warren, Ohio, has a cutting range of ⅛ to 2 in. Castings are of malleable iron and the cutting wheels are of

electrically heated alloy steel. The tool may be used either as a one- or three-wheel cutter.

Chisholm-Moore Electric Hoist

AN electric hoist designed especially for operation under low head room conditions has been announced by the Chisholm-Moore Hoist Corporation, Tonawanda, N. Y. This unit, known as the "Hi-Up" hoist, measures 13 ft. from the bottom of the runway beam to the bearing point of the lower hoisting hook. Units are supplied with lug suspension for stationary mounting or with ball bearing, push-button-type trolley. Standard push-button control is used.

Rotating parts ride on Hyatt roller bearings in a continuous grease bath. The motor is fully inclosed and is equipped with a magnetic brake which prevents drifting of the load.

Woodack Electric Drill

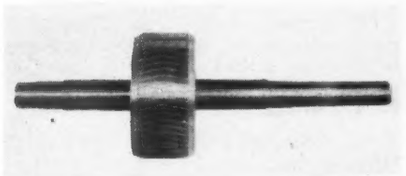
AN electric hand drill which may be used on wood, metal, and masonry has been introduced by the Wodack Electric Tool Corporation, 4627 West Huron St., Chicago, Ill. In addition to operation as a hammer, the tool may also be used as a rotary drill covering the entire range of sizes from 0 to ⅜ in. in metal, and ½ in. in wood. It weighs 12 lb. and is furnished with a metal carrying case and star and twist drills. Grinding, scratching, and buffing wheels, and a bench stand can also

be furnished, as well as a stand for converting the tool into a drill press.

Sterling Herringbone Rotor

IMPROVED electrical characteristics and noiseless operation are features emphasized by the Sterling Electric Motors, Inc., Telegraph Rd. at Atlantic Blvd., Los Angeles, Calif., in introducing herringbone rotors for motors of from 1 to 50 h.p. capacity.

Their use in motors on applications



such as fans, direct-connected pumps, and so on, is intended to eliminate end thrust, bearing noise, and improve pull-out efficiency and power factor.

Matthews Solderless Service Connectors

SOLDERLESS service connectors introduced by the W. N. Matthews Corporation, St. Louis, Mo., necessitate the use of but two pieces in handling. The clamping member is made of rolled copper; the swivels are within the nut and cannot come out.

TRADE LITERATURE

You Should Know About

Copies of literature which is described on this page can be obtained by writing to the manufacturer whose name and address are mentioned. It is always advisable to state the name and number of bulletin or catalog described, as given in these columns.

* * *

(1) PUMPS — Bulletin 1647, 16 pages, Type SSU centrifugal pumping units.—Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

(2) SCREWS—Bulletin, 24 pages, hardened, self-tapping, sheet-metal and metallic drive screws.—Parker-Kalon Corporation, 200 Varick St., New York, N. Y.

(3) CONVEYOR CHAIN — Catalog "Defco" drop-forged conveyor chains.—Detroit Forging Company, Detroit, Mich.

(4) PUMPS — "Axiflo," "Hiflo," and "Coniflo" deep well pumps.—Worthington Pump and Machinery Corporation, 2 Park Ave., New York, N. Y.

(5) MAINTENANCE EQUIPMENT—Catalog 16, 40 pages, electrical and mechanical maintenance equipment.—The Martindale Electric Company, 1260 W. 4th St., Cleveland, Ohio.

(6) SPEED REDUCERS—Bulletin 49, Series OH, worm-gear speed reducers.—W. A. Jones Foundry & Machine Company, 4401 Roosevelt Rd., Chicago, Ill.

(7) POWER FACTOR—Bulletin "Power Factory Control and Voltage Regulation on Motor-Generator Sets with the Melton Control."—Melton Control Company, Inc., Punxsutawney, Penna.

(8) MANAGEMENT — "Index of Economic Reports," a classified index of the publications issued by the Policyholders Service Bureau. — Metropolitan Life Insurance Company, 1 Madison Ave., New York, N. Y.

(9) MATERIALS HANDLING EQUIPMENT —Bulletin, 34 pages, hand trucks, skids, barrows and other hand-power equipment.—Lansing Company, Lansing, Mich.

(10) LIGHTING—Portable and stationary lamp guards and protectors.—McGill Manufacturing Company, Valparaiso, Ind.

(11) INSULATION — "Insulation Handbook," 1931 edition, technical data, construction methods, insulation details, blueprint specifications and manufacturer's catalog data. — United Cork Companies, Lyndhurst, N. J.

(12) TACHOMETERS — Catalog 46, 16 pages, indicating and recording tachometers in various models, together with description of the electric generators used in their operation.—The Brown Instrument Company, Philadelphia, Pa.

(13) LIGHTING — Catalog 31, 26 pages, adjustable and portable lighting fixtures and a large variety of "Daylight Units." —The O. C. White Company, 15-21 Hermon St., Worcester, Mass.

(14) POWER TRANSMISSION — Bulletin 1274, 16 pages, "P.I.V. Gear" an all-metal, variable-speed transmission.—Link-Belt Company, 910 S. Michigan Ave., Chicago, Ill.

(15) STORAGE TANKS — Bulletin, 18 pages, vitrified, glazed-tile, ash-storage tanks.—United Conveyor Corporation, Old Colony Building, Chicago, Ill.

(16) MOTORS—Circular 1883, construction details and applications of the various types of Westinghouse small power motors.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Coming Events

National Electrical Manufacturers' Association—Midwinter meeting, New York headquarters, Jan. 19-23. A. W. Beresford, 420 Lexington Ave., New York, N. Y.

American Institute of Electrical Engineers—Annual winter convention, New York City, Jan. 26-30, 1931. Secretary, F. L. Hutchinson, 33 W. 39th St., New York, N. Y.

Fifth Midwest Engineering and Power Exposition—Coliseum, Chicago, Feb. 10 to 13, 1931. Managers, Midwest Engineering Exposition, Inc., 308 W. Washington St., Chicago, Ill.

Second National Western Metal Congress and Exposition—Civic Auditorium, San Francisco, Calif., Feb. 16-20, 1931. Under auspices of A.S.S.T. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

Second National Industrial Congress Featuring Management, Maintenance and Materials Handling—Public Auditorium, Cleveland, Ohio, April 13 to 18, 1931, inc. In conjunction, Second National Industrial Equipment Exposition. Concerning technical sessions address P. T. Wetter, American Society of Mechanical Engineers, 29 West 39th St., New York City. Exposition under management Midwestern Engineering Exposition. 308 West Washington St., Chicago, Ill.

National Fire Protection Association—35th annual meeting, Toronto, Can., May 11 to 17, 1931. Association headquarters, 60 Batterymarch St., Boston, Mass.

National Electric Light Association—54th convention and exhibition, Municipal Auditorium, Atlantic City, N. J., June 8 to 12, 1931. Frank H. Gale, Secretary-Treasurer, 420 Lexington Ave., New York, N. Y.

(17) TESTING—Bulletin, 8 pages, "The Protective Value of Independent Inspections."—Pittsburgh Testing Laboratory, Stevenson and Locust Sts., Pittsburgh, Pa.

(18) MATERIALS HANDLING — Bulletin B-27, 12 pages, locomotives with McCormick-Deering power in 4-, 4½-, 5-, 6-, 8-, 10- and 12-ton sizes.—Brookville Locomotive Company, Brookville, Pa.

(19) COAL PULVERIZER—Bulletin 5-80, 4 pages, construction and operation details of the Type B pulverizer.—Fuller Lehigh Company, Fullerton, Pa.

(20) OIL REFINING EQUIPMENT—Bulletin, index of equipment made by this company for special applications in the oil refining industry.—Coppus Engineering Corporation, Worcester, Mass.

(21) ELECTRIC FANS — Catalog 42, 18 pages, a complete line of standard desk, ceiling, and floor, bracket, and exhaust and ventilating fans.—Diehl Manufacturing Company, Elizabethport, N. J.

(22) WROUGHT IRON — Bulletin, 22 pages, a description of the new method of manufacturing wrought iron under the Aston Patents.—The A. M. Byers Company, Clark Building, Pittsburgh, Pa.

(23) FURNACE DESIGN—Catalog 30, 36 pages, theory, design, and construction of Economy air-cooled walls. — Furnace Economy Company, 407 S. Dearborn St., Chicago, Ill.

(24) LIGHTING — Bulletin, Thompson safety lowering hanger.—The Thompson Electric Company, 1438 W. Ninth St., Cleveland, Ohio.

(25) MOTORS — Publication GEA - 1294 Type MPC, d.c. motors, base and pedestal-bearing construction for moderate or heavy duty.—General Electric Company, Schenectady, N. Y.

(26) GENERATORS — Bulletin 95, 12 pages, diverter-pole generators for floating with bus control batteries.—The Electric Products Company, Cleveland, Ohio.

(27) POWER TRANSMISSION — Catalog 102, IXL Titan, helical-gear speed reducers. — Foote Bros. Gear and Machine Company, 111 N. Canal St., Chicago, Ill.

(28) ELECTRICAL EQUIPMENT—Bulletin, Knopp phase sequence indicators.—Meter Devices Company, Canton, Ohio.

(29) WELDING — Bulletin, 12 pages, welding accessories and supplies.—Fusion Welding Corporation, 103rd St. and Torrence Ave., Chicago, Ill.

(30) UNIT HEATERS—Catalog 469, 20 pages, five different types of unit heaters.—Buffalo Forge Company, Buffalo, N. Y.

(31) PIPE THREADING MACHINES—Bulletin C-61, 12 pages, 6- and 8-in. Landis pipe threading and cutting-off machines. —Landis Machine Company, Waynesboro, Pa.

(32) METERS—Bulletin 37, 52 pages, "Mechanically Operated Fluid Meters."—Bailey Meter Company, 1050 Ivanhoe Road, Cleveland, Ohio.

INDEX

INDUSTRIAL ENGINEERING

1930 EQUIPMENT NEWS

All of the items listed were described in the Equipment News Section during 1930. Reference symbols refer to issues and page numbers. The following abbreviations are used to indicate the months: Ja—January; F—February; Mr—March; A—April; My—May; Ju—June; Jy—July; Au—August; S—September; Oc—October; N—November; D—December.

This index, filed with the twelve 1930 issues, will constitute a valuable equipment guide. Separate copies of the index will be furnished upon application to the editor.

AIR CONDITIONING EQUIPMENT

Heater, deaerating..... Au435
Humidifier, centrifugal-type.... A211

BATTERY CHARGER

Battery charger..... Ja60

COMPRESSORS, PUMPS AND ACCESSORIES

Compressors: air, two-stage, automatic, electric, Ja58; portable, gas-engine-driven, Ja65; single-stage, automatic, electric, F111; two-stage, heavy-duty, motor-driven A219
Gasket compound..... A220
Gasket cutter..... Au436
Joint, expansion, cylinder-guided, steel..... A220
Proportioner, liquid, automatic. Au440
Pumps: centrifugal, self-priming, 60-g.p.m, 60-ft. head, Ja63; single-stage, 1,800-g.p.m., 300-ft. head Mr155; air-motor-driven, 125-g.p.m., 43-ft. head, Ju315; Hydro-acid, 60-, 150-, 300-g.p.m., Jy392; rotary, valveless, ½-, 1-, 2-g.p.m., Au435; turbine, deep-well 25- to 6,000-g.p.m..... Au435
Trap, steam, balanced-valve, low-pressure S486
Unions, forged-steel, ⅛- to 2-in.. Ja65
Valves: check, noiseless, F109; acid-resisting Y, A214; air-relief, My273; coupling and shut-off, Ju327; bonnet, one-piece..... N589
Washers, metal parts, standard and rotary drum-type..... F109

CONTROL EQUIPMENT

Cells, photo-electric Mr213, Jy393, Oc541
Contactors: magnetic, heavy-duty, a.c., Au436; small-motor, reversing S486
Controllers: dynamic braking, F106; magnetic, steel mill auxiliary, Mr153; lifting magnet, Ju317; two-speed, consequent pole, automatic N586
Control: crane and hoist, magnetic, Mr154; generator, gasoline-engine-driven, A215; reversing (up to 2 hp.), Oc536; audio-frequency, remote N587
Inclosures: motor-starter, gas-tight, Ja59; dust-tight..... S485
Mechanisms, solenoid-operating. N590
Method for changing electroplating generator voltage..... Au432
Push buttons.....Ja64, D641
Regulator, power factor control and voltage..... D637
Relays: photo-electric, My277, Ju328; mercury tube..... D641
Resistors: edgewise-wound, heavy-duty, Au439; voltmeter multiplier S485
Rheostats, speed-regulating, d.c. Ju316
Signal, crane Mr159
Starters: magnetic, with motor circuit switches, F110; manual, air motor, A214; with fusible switch, Ju326; full-voltage, Au433; two-pole a.c. and d.c., S483; resistor, fractional d.c. and single-phase a.c., motor, S490; a.c. (up to 7 hp. at 550 volts), Oc537; combination, a.c., Oc540; remote (up to 10 hp. at 230 volts) d.c., N585; across-the-line, oil-immersed, D638; non-reversing... D640
Switches: emergency stop, Mr152; control, three-position, s.p.d.t., Mr157; starting, single-phase (up to 3 hp. at 220 volts), A213; combination, line starter and safety, A214; pressure, auto-

matic, A220; limit, single-post, Ju318; test, meter, and relay, Ju323; time, electrically wound, S483; pressure regulator, single-pole, My277; time, automatic, Ju321; quick make-and-break, 575-volt, Ju323; weatherproof, t.p.s.t., Ju328; magnetic-reversing, inclosed, Au435; push-button, explosion-proof, Au441; pilot, three-piston, S491; starting, resettable, automatic, Oc537; time, conduit-connected base, Oc538; starting (up to 2 hp. at 550 volts), N589; float, automatic, contactor-type, D635; magnetic, latched, D637; starting, normal and high-torque motor (up to 2 hp.), D640; magnetic, three-pole, 200-amp., oil-immersed..... D643

Timer, work-cycle, electric..... D636

HEATERS, HEATING AND VENTILATING EQUIPMENT

Babbitt pot, electric, bottom-pouring Jy392

Cleaner, air, motor..... My269

Control, dual, unit-heater..... Mr154

Cooler, fan..... Jy393

Elements, heating, immersion-type D635

Gas for controlled-atmosphere furnaces Ju316

Heaters: water, electric, storage-type, Mr155; electric, oven-type, S483; space, electric, S485; solder-iron, electric D641

Heating system, hot-air, direct, A210; electric heat, fan-circulated. My273

Insulation, high-temperature... Oc541

Ovens: electric, controlled-heat, My272; gas-fired, indirect.. My275

Pulverizer, coal N587

Tank, melting, electrically heated A218

Traps: blast, unit heater, My277; steam, bellows-type..... Au436

Unit heaters: combined air-cleaner and air-moistener, Ja65; fan-type, Mr153, Mr159; cell-type, A216; built-in type, A221; floor-, and ceiling-type, My271, Au433; suspended-type, My276, Ju325; gas-fired, multiple, Ju324; twin-type, Au439; motor-driven, portable, Oc541; gas-fired, electric fan-driven, N591; suspended-type, adjustable, D638; cabinet-type, D639; turbine-driven..... D641

Valves: radiator, packless, automatic, A219, S488; unit-heater, motor-driven Jy392

LIGHTING EQUIPMENT AND ACCESSORIES

Flashlight, revolving-head Au432

Fixture, ventilated A213

Guard, lamp, portable..... S490

Hanger, removable My276

Lamps, inside-frosted, 150-, 200-, 300-, and 500-watt..... D640

Panelboard and cabinet, combination Oc536

LUBRICANTS AND LUBRICATION DEVICES

Panelboard unit Oc541

Filters: oil, automatic, bypass-pressure, A211; metal-element... My274

Lubricators: automatic, heavy-duty, Jy395; mechanical, S481; automatic, progressive, S484; universal, Oc535; pressure, portable.. N591

Lubricants: gear, D639; motor.. D642

Oiler for chain drives, ring, automatic D634

Pump, grease, motor-driven.... Ju323

MATERIALS HANDLING EQUIPMENT AND ACCESSORIES

Bucket, clamshell, heavy-duty... S490

Bumper, tractor Ju320

Boxes, stacking, steel..... Ju318

Carrier, conveyor-belt N588

Chains: conveyor or drag, Mr155; conveyor, standard and light service N591

Conveyors: elevating and tiering, portable, Au440; roller, heavy-duty D643

Cranes: storage-battery powered, portable, heavy-duty, S483; variable-height, portable D634

Dipper doors, manganese steel. Oc538

Elevators: portable, manual or electric, Oc538; stationary, power-driven N590

Felloe, truck-tire, changeover.. Oc535

Hoists: air or steam, single-drum, F107, Ju317; electric, A215, Ju324, Jy395; hand, Ju326; portable, single- and double-drum D643

Loaders: skip-hoist, automatic, A213; box car, heavy-duty..... My276

Locomotives, gasoline-powered. Au440

Rim, truck, heavy-duty..... D636

Safety stop, conveyor..... Au438

Screen, vibrating, multiple-deck, steel Ja64

Shoe, track, tractor..... Ju316

Stacker, gas-engine-driven and hand powered D643

Tongs, chain, reversible-jaw... Mr157

Tractors: gasoline, F110, Ju316, Ju324, Jy394; crawler, Oc539 three-wheeled, N588; snow-plow.. N589

Trolleys: overhead, plain and geared, My275; cab-operated, motor-driven Ju325

Trucks: low-lift, electric, Ja63; conveying and tiering, storage-battery, Ju325; lift, hand-operated, S489; lift, power-operated, S491; shovel, electric, four-wheel-drive, Oc535; tier-lift, electric, telescopic, Oc537; lift, gas-electric, (1¾ and 10 tons) N584; shovel, electric, 9-cu. ft., N585; floor, standard and special, N585; floor, telescopic D642

METERS, GAGES AND ACCESSORIES

Ammeter, motor-starting A218

Caliper, micrometer F109

Caliper, dial Mr159

Comparator, gear-tooth Oc538

Detector, gas A219

Gages, depth, graduated, Mr152; attachment for..... Mr156

Gages: telescoping, F107; screw-thread, A217; wire selector, A221; radius, Au438; fillet and radius S482

Gages: pressure, remote-type, transmitting, A210; air-filter..... Ju319

Instruments: selsyn-operated, Mr153; indicating, a.c. and d.c., A219; graphic, a.c. and d.c., My269; kva.-demand, N585; pocket-type, volt-ammeter, d.c., N588; recording, circular-chart, switchboard-type D637

Manometers, U-tube Ja63, A220, Ju326, D639

Megohmer A217

Meter, heat-flow Ja59

Meter, frequency, indicating... Mr159

Register, stop watch and speed, combined A215

Rotoscope (speed analyzer)..... N591

Scale, dormant, computing..... A215

Shock absorber, pressure-gage . My272

Tachometers: air-velocity, A212; geared, stationary..... Ju328

Template, laminated Ju322

Tester, circuit A221

Tester, dry-cell Ju325

Tester, weld specimen, portable. D640

Thermometer, recording F111

Thermostats: heating-unit, Ju320, S491; unit-heater..... Ju329

Viscosimeter, automatic Jy395

MOTORS AND GENERATOR EQUIPMENT AND ACCESSORIES

Bases for m.g. sets, steel..... Jy275

Brushes, motor, mill and hoist.. S485

Converters, frequency My273

Dynamotors N590

Generator: power-plant, portable. S491

Motors: squirrel-cage, fan-cooled, Mr153; sealed, a.c. and d.c., Mr154; induction, 3,600-r.p.m. (up to 1,250 hp.), Mr156; ball-bearing, Mr156; capacitor-type, high-torque, A217; induction, explosion-proof, Ju319; induction, semi-inclosed, Ju322; welded, d.c., Jy392; runout-table, Au439; split-phase, clutch-type, S487; induction, fan-cooled, 1,200-r.p.m. (up to 20 hp.), Oc537; fan-cooled, a.c., Oc541; explosion-proof, d.c., N587; 1,125-r.p.m. (1/20 and 1/12 hp.) and 1,725-r.p.m. (1/10 and ⅛ hp.), D635; totally inclosed (for hazardous conditions, and up to 30 hp.), D636; totally inclosed (up to 50 hp.)..... D638

Motor-generators, low- and high-speed, light-duty N590

PAINT AND PAINTING EQUIPMENT

Air brushes, multi-color..... Au432
Conditioner, paint D640
Paints: aluminum, heat-resisting, Jy393; quick-drying, weatherproof Oc541
Sprayers: paint, round or fan, Au438; one-gun, S487; portable, unit-type D637
Stripers: paint, universal, continuous Ja58, Ju321

PLANT SERVICE EQUIPMENT AND MATERIALS

Blueprinting machine, automatic My274
Cleaner, vacuum, tank-type.... My274
Cleaner, blower and vacuum, combination Ju328
Clocks, electric, wall-type..... N591
Compounds, cement and mortar Oc539
Flooring, steel-armored..... My270
Insulation, vibration-arrester.. My271
Liner, floor Ju317
Marker, guide and obstruction, airplane N590
Mask, face, rubber..... A216
Roofing, steel, galvanized..... D634
Screens, woven-wire.....Ju324, S487
Scrubber and absorber, floor, combination S486
Shower fixture, group..... N587
Surfacing material, floor..... A215
Tile, wall, asbestos..... A220
Wire cloth, stainless-steel..... N588

POWER TRANSMISSION EQUIPMENT

Bearings: ball, sealed, S482, thrust, Au437; self-lubricating, F105; bronze, steel-backed, A216; split, sealed-sleeve, Ju317; take-up, belt-conveyor Ju329
Bearing bronze, high-lead..... My275
Belts: leather, short-center, F107; static-proof, Jy394; fabric... S491
Belting, leather, cemented..... Ju392
Brake wheels, mill-motor..... A220
Chains: drive, alloy-steel, Ju327; cast metal..... S415
Clutches: automatic, Mr158, Au434; adjustable, My273; magnetic D640
Compounds, lapping, bearing... Jy393
Couplings, flexible, Ja61, Mr157, A211 ..... Au441
Countershaft, motorized Jy393
Covering, belt, plastic, self-vulcanizing D642
Drives: mill, two-speed, Ja62; elevator, F108; screw-conveyor, A212; chain Au437
Lacing, belt, flexible-steel..... Ja61
Pulley, ball-bearing My270
Speed Reducers: three-speed, Ja64; right-angle drive, F105; spiral bevel gear, right-angle, A214; fixed-ratio and variable-speed, A216; herringbone and helical, Ju322; helical-geared, Ju329; gear unit, two-speed, N586; standard, single- and double-reduction, D638; planetary gear motorized..... D639
Transmissions: variable-speed, Jy394; P.I.V. gear..... N584
V-belts, multi-....Jy394, Au439, N588

SHOP TOOLS AND MATERIALS

Bandsaw tire Au432
Bench legs, T-iron..... F107
Buffer, gooseneck-base, motor-driven Ju325
Buffing wheels, cushion-abrasive Au438
Cabinets, steel Ju321
Cable grip Jy394
Cast iron, wear-resistant, high-strength Ja64
Cement, chromite, high-temperature F106
Clamp, steel, light-duty..... Ju325
Crowners, screw-head, concealing A212
Cutter, timber, heavy-duty.... Mr154
Degreaser, vapor-bath Ja59
Die heads, bolt (⅛ to 1 in.).... N588
Die stocks: pipe, three-way, S488, D637; four-poster..... Au437
Drills: electric, portable, Ja63, Au437, Au438; pneumatic..... Oc540
Drilling stand, radial..... F111
Floor-scrubber and polisher, motor-driven Au441
Former, coil, air-operated..... Mr270
Fuse-puller, fiber, cartridge-type My277
Grinder and buffer, pneumatic... F106
Grinders: air-driven, Mr154, Ju315, D641; disk, electric, portable, Mr158; bench-type, electric, portable, Mr159, Au434; snagging, high-speed, Ju315; pedestal-type, Au433; hand, N590; commutator Au439
Iron, high-permeability Ja65
Lathes: polishing and buffing, F107; finishing A218
Lockwashers: stainless-steel.... Ju323
Nibbling machine, power-driven Oc540
Pipe benders: motor-operated, Ja64, Ju315; hydraulic..... Ju321
Pipe reamer, four-inch..... S487
Pipe threaders: power-driven, portable, Ju320; reamer, hand, Jy394; three-way, Au432; motor-driven, S488, S489; gasoline-engine driven S489
Puller, gear and wheel..... D642
Punches: combination, Ja60; draw, hand-operated S484
Hammers, chipping, pneumtaic.. F108
Radial arm, hand-saw, electric. My272
Rubber, X-ray-resistant Ja60
Sander, crane wheel, electromagnetic A218
Sander and grinder, belt..... Oc539
Saws: electric, portable, 10-, 12-in. blade, Ja61; 1¾-, 2½-, 3½-in. capacity, Ma269; 2⅝-, 4⅛-, 4½-in. capacity, Ju327; 2-, 3-, 4-, 6-in. blade, Jy395; 3⅛-in. capacity, N586; jig..... D635
Screw drivers, insulated..... S487
Screwnail, hardened steel..... Ja64
Shaft, flexible S489
Soldering irons, electric..... Mr155
Stands, steel, vise and pipe-bending Oc536
Stripper, wire, pedestal-type... D643
Tank, dipping, insulation-varnish Ju326
Tools, grooving, joint..... Ja61
Tool chests: machinist's, Ju320; general purpose, all-steel, Ju321; combination Ju323
Undercutters, lathe-type.F111, Mr156
Vises, plain and swivel..... A219
Wrapping rolls, metal-cylinder. Mr156
Wrenches: socket, forged-steel, Ja62; adjustable, Ju323; fuse, ferrule-type Au441

SUB-STATION EQUIPMENT

Bends, expansion, rigid-conductor Mr156
Blade and contact unit, switch, disconecting D636
Bus fittings N589
Bus supports, heavy-duty..... .....S489, My272, Oc540
Circuit breakers: oil, outdoor-type, A217, S484, S486; manhole-type, My276; air, trip-free, Ju319; oil, indoor-type, Au434; metal-clad Au437
Clamps, disconnecting, live-line Ju319, Oc539
Connectors: wire, solderless, clamp-type, Oc538; screw-type... N590
Contact, floating, disconnecting switch S482
Cutouts, fuse, primary..... Ju327
Fuse, expulsion, self-insulated... S481
Insulators: outdoor-apparatus, F108; switch-shaft S490
Joint, support and expansion, combination Mr157
Lever, manual-operating, oil circuit breaker Oc535
Lightning arresters, dry-type. F110, Ju329
Motor mechanism, disconnecting switch Ju318
Panel, distribution F106
Pedestal, disconnecting switch, gang-operated Ju318
Switches: disconnecting, double-blade, tongue-type, Ja62; side-opening, Mr153; pole-type, gang-operated, Mr158; vertical-mounted, A216; transfer-type, type, My273; double-blade, My274; by-pass, outdoor-type, Ju218; heavy-duty, indoor-type, Ju319; back-connected, Au433; combination transfer, Au434; gang-operated, double-throw, Au434; indoor-type, s.p.s.t. and d.t., Au436; outdoor-type, horizontal-break, S488; gang-operated, three-pole, 66-kv., S490; selector, S491; pipe-frame mounted. N589
Switches: knife, heavy-duty, Ja58; auxiliary, unit-type..... Ju327

Switch gear, cubicle-type, indoor Ju315
Switch house, steel, totally inclosed My276
Terminators: cable, low-voltage, Ja60; cementless, S485; three-conductor, compound- or oil-filled, D638; three-conductor, unit-type D643
Transformers, current, instrument N591
Voltage regulators, automatic... Ja58

WELDING EQUIPMENT

Arc welders: portable, motor-driven, 30-750 amp., Ja59, A220, A221, Au439; gas-engine-driven, 400-500 amp. S481
Blowpipes welding, A217; accessories for Oc538
Brazing equipment, electric.... Oc540
Burner, kerosene Mr152
Dissociator, ammonia (to obtain hydrogen gas for atomic hydrogen welding) D634
Electrodes: welding (for stainless steels), My270; light-gage material, Ju321; general-purpose... S488
Feeding device, welding-electrode, automatic Ja60
Generator, electric, arc-welding, motor-driven, portable..... F109
Generators, acetylene, non-automatic, stationary, S482; automatic, portable N587
Holder, electrode Au437
Manifolds, oxygen and acetylene Au441
Putty, fillet Au440
Regulators: multi-stage, gas, Ja65, My272; two-stage....Ju322, Oc538
Torch, cutting, gasoline, N588; blow, alcohol S487
Valve, shut-off, welding-gas.... F108
Welding rods: steel, F111, Mr152, A218, Ju320; aluminum.. Oc536

WIRING AND DISTRIBUTION EQUIPMENT

Brackets, resistance-unit S486
Cables: contact, remote-control, A221; sheathed, non-metallic. Ju328
Clamp, fuse-clip Jy393
Conduit fittings, malleable, threadless My271
Connectors: plug, Mr157; cord, multi-pole S487
Couplings and connectors, vapor-proof My271
Fuse plugs Ja63
Locking ring, outlet..... Ju319
Locking device, lamp..... Au436
Locking ring and cap, attachment plug S489
Outlets, moisture-proof Ju329
Outlet box, steel..... S485
Oil, soldering Au440
Panelboards: fuseless, Mr158; unit-type, safety N586
Pedestal switch S488
Receptacles: flushplate, Ju326; flush, duplex D642
Reels, cable, steel..... D636
Supports, insulator S484
Switches: inclosed, fused, Ja61; tumbler, Ja63; multi-pole, disconnecting, Ja63; multiple-break, F105; tumbler, three-pole, flush-mounted, F110; tumbler, flush.... D639
Trimmer, knockout Jy395
Wire: magnet, asbestos-insulated, Ja59; code, No14, intermediate and 30 per cent grades, Mr155; rubber insulated..... N586
Wires and strands, steel, copper-covered Ju325